THE

ELECTRICAL REVIEW.

VOL. LV. AUGUST 19, 1904. No. 1,395.

ELECTRICAL REVIEW.

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THE

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1904 Edition

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THE TELEGRAPH DEFICIT.

THE annual deficit of the Telegraph Service is a fruitful source of tribulation, and is sometimes used for comparative purposes in a manner which is, to say the least, misleading. The *Daily Chronicle* of the 11th inst. is impelled by the recent discussion of the Post Office vote in the House of Commons to suggest "that the present is a convenient opportunity for inquiring into the why and wherefore of this annual loss." Our contemporary commences its inquiry by quoting the concluding paragraph of Mr. Austen Chamberlain's Report as Postmaster-General for the year ending March 31st, 1903, viz.:—"If allowance be made for interest on the capital — £10,867,644 — created for the purchase of the telegraphs, the telegraph deficit on the year is raised to £892,365." Our contemporary adds that "... if allowance also be made for a sinking fund which should eventually extinguish the loan debt, the deficit is raised to a sum far beyond a million sterling."

The "expert correspondent" who is responsible for the article referred to, goes on to suggest that Mr. Austen Chamberlain's successor "must have felt a mild surprise on taking office, at the fact that the governing body, which carries on the letter post so successfully as to enrich the Exchequer by several millions of pounds annually, is so unfortunate in its administration of the telegraphs as to incur, year by year, a formidable loss."

We will not discuss the remedies which the "expert" recommends. We only desire to refer again to the nature of the deficit because it is obvious that it is not so generally recognised as, we think, it should be. We have had frequent occasion to remark upon the advantages of private enterprise and the occasional disadvantages of public enterprises, but it is essential in all comparisons that the conditions on either side should be equal. If the scales do not balance before the weights and the substance to be weighed are put into them, no reliance can be placed on the subsequent results. Our contemporary suggests the need of a sinking fund to extinguish the capital, and numerous comparisons have at times been made between the "deficit" of the Post Office telegraphs and the "dividends" of similar undertakings in the hands of companies.

In order that the scales may be even it is essential to remember that whilst private enterprises—and, too often, municipal enterprises also—may go on increasing their capital accounts, the capital account of the Post Office Telegraphs is closed, and all extensions are, and have been for the past 13 years, provided out of revenue. In the year to which Mr. Austen Chamberlain's quoted remarks apply, the deficit still existed without taking the extensions into account, but it assumed a more modest character—the £892,365 which he mentioned being made up as follows:—

Interest on capital, £298,860; sites, buildings, and telegraph extensions, £490,155; the actual deficit on working account being only £103,350.

When comparisons are made between the financial results of the postal and telegraph services, it seems to us essential to bear in mind the comparative absence of expenditure of a capital nature in the one case, and the pressing need of extensions in the other. In the accounts of the Postal Services the only expenditure in the nature of capital outlay is "sites and buildings," and these together (in the same year to which Mr. Chamberlain referred) amounted to £313,088, out of a total expenditure of £10,818,066, whilst the Telegraph Department on similar items and extensions had an expenditure of £490,155 out of a total of £4,317,371, or 2·89 per cent. in the postal service, and 11·35 per cent. in the telegraph service. It is clear, therefore, that the easiest way to avoid telegraph deficits is to avoid telegraph extensions. It would be unfortunate if any uninformed criticisms should tend to such a result. This, however, seems unlikely, since no notice appears to be taken of such criticisms by those in authority.

One exception to the contrary, however, occurs to us. In his presidential address to the members of the Institution of Civil Engineers, Sir William Preece, in the course of his remarks on telephony, expressed the opinion that "telephony is an Imperial business, like the post and the telegraph." One of the causes which existed to impede the desirable absorption was "the assumed bad bargain made in absorbing the telegraphs in 1869." This he characterised as a "gross fallacy." The business of the telegraph companies was purchased for £4,989,048. "The number of messages then sent in one year was about 5,000,000, and the gross income about £500,000. The income has now [1898] grown to £3,071,723, the number of messages has reached 83,029,999, and the capital account, which was closed in 1891—viz, £10,131,129, including the cost of the Post Office extensions, remained the same. If a syndicate desired now to repurchase the business and acquire the plant, they would have to find a capital of over £30,000,000." Sir William went on to ask "in what respect, then, was the transfer of the telegraphs to the State a failure?" And he answers, "Our magnificent system has been built virtually out of revenue, our tariff is very cheap, scarcely a village of any consequence is without its telegraph, our press is virtually subsidised by having its news supplied at much less than cost price; we can rely upon safe and accurate delivery, and upon speedy dispatch of messages. We lead the world. There has been no failure, and there was no bad bargain."

Presidential addresses are not subject to discussion, and we have, consequently, no criticisms to quote. Doubtless at the present time a number of people would desire to enter the lists on the opposite side, but apart from any expressions of opinion, Sir William Preece's remarks summarise certain facts which should be more generally known and more familiarly recognised:—The purchase of the Telegraphs cost, in round figures £5,000,000, the Post Office spent in the 21 years following the purchase another £5,000,000. The two sums together form the capital account, and since 1891 all further expenditure of a capital nature has been out of revenue. We do not believe in deficits; we see no reason why the users of the telegraph should not pay the cost of the service rendered, or why the press should be subsidised at the expense of the public, but in justice to a section of the Post Office department which is second to none in zeal and efficiency, as well as for the proper consideration of important problems, we have thought it desirable to explain, to some extent, what telegraph deficits mean.

The Workmen's Compensation Act.

THE extraordinary amount of litigation to which the Workmen's Compensation Act gave rise, compelled the Government to appoint a Home Office Committee to inquire into the working of the Act. This body have now issued their report, which embodies certain recommendations of great importance to those who are affected by the Act. The Committee think that, while the litigation which has arisen out of the Acts "has been very small, when compared with the great number of cases settled by agreement," the proportion might, and should be, still further reduced. It might have been thought that the effect of increased liability for accidents would have been to increase the safety of workmen. The Committee, however, express the opinion that the measure has not had any marked or ascertainable effect one way or the other upon the safety of workmen. It is stated that it has certainly very largely put an end to those societies for accident indemnification, which were kept going by the joint contributions of masters and men. While the Committee hold that the burden on the employer has, so far, not been excessive, they take the view that it tends to increase, and that great caution should be observed before it is materially augmented, especially by any legislation which may add to the indefiniteness and uncertainty of his liability. They maintain that the Acts have conferred substantial benefits on those classes of workmen who are in a position to take advantage of them, but think that cases not infrequently occur where the good effects are considerably curtailed. In nearly all instances this arises from a lack of clearness in the drafting of the laws, and they propose numerous amendments, which it is hoped will have the effect of removing ambiguities which have pressed hardly upon individual sufferers from industrial accidents. The Committee also suggest that the principle of the Act of 1897 should be extended to seamen, fishermen, carriers, workers in workshops (where five or more persons are employed), and those engaged in the management of horses and locomotives.

The recommendations of the Committee which are most likely to be of special interest to the electrical world may be summarised as follows:—By Paragraph 8 the Committee suggest that the word "railway," in the Act of 1897, should include lines and sidings not used for purposes of public traffic, and also tramways. If this suggestion is adopted, persons employed on every electric tramway in the kingdom will be entitled to compensation, and this, whether the part of the line in question is open to public traffic or not. It is true that there is a report of a case on the books where the provisions of the Act were applied to a person working on a tramway. The recommendation of the Committee, however, will have the effect of rendering the position still clearer.

By paragraph 14 the Committee recommend that under the connotation of the term "engineering," road making and mending, well sinking and repairing, and other excavation, as well as the construction or maintenance of *telegraphs, telephones and other electric appliances, should be included.*

Paragraph 15 provides:—"That the operations of the Act should be extended to include accidents which happen to the workmen engaged on the duties of his employment, but not at the place or premises where the employer has superintendence or control."

This suggestion, if adopted, will have the effect of making a firm who supply and fix electrical fittings, responsible for injuries sustained by their employés while engaged, say, upon a wiring job far away from their employers' works.

Paragraph 20 is of general interest, inasmuch as it will enable an employer to take into his service a man who is infirm, and so especially liable to meet with disablement. It provides :—"That with reference to the employment of aged, infirm, or maimed persons, amendments should be made to enable the employer to offer work to such persons without incurring undue risk of having to pay compensation."

Looking at the general result of the labours of the Committee, we are persuaded that, if adopted, they will have the effect of lessening the ambiguity which now surrounds the interpretation of the Workmen's Compensation Acts, 1897 and 1900.

The Care of Car-wheels.

NOT so much because of its American origin as for its universally sound teaching, we notice here a practical article on the "Inspection and Care of Car-wheels" in the July *Street Railway Review*. The superintendent of the Chicago Elevated wrote it, and, incidentally, he writes only of steel-tired wheels. Systematic and thorough records are made of every one of the 876 pairs of wheels under the motor and trail-cars, and, although no more than 91 pairs have been turned down since the road started in 1900, yet every axle and every wheel is inspected in position at intervals of 60 days, and the condition of each is recorded on a special form.

Users of steel tires will be wise to note that the superintendent finds it an uneconomical policy to run wheels until they fail to pass the inspector, before sending them to the shops, for in many instances much more turning has to be done than would have been required if the wear had not become so pronounced. The cause of the wear should be ascertained and removed as soon as possible, and it should never be necessary to turn down the tread itself except to eradicate a flat spot or an oval periphery.

To attain this end, the Chicago Elevated have introduced a simple but thorough system of gauging. With one gauge thick flanges are discovered ; while with another flat spots, sharp flanges, thin flanges and hollow treads, are challenged.

Thorough inspection of this nature must result in economy, and the actual cost of inspection, even when carried out by the foreman on a small system, or by a special car inspector on a large one, would not be noticed when reduced to pence per wheel per annum. It is morally certain that inspection will be useless if it is left to underlings.

The trouble about records is that the foreman has to be specially constructed to understand their vital nature, and to keep them with the requisite accuracy and attention. The most perfectly elaborate system of forms is only too likely to be rendered nugatory by an irregular slip-shod foreman. It is a simple matter for a manager to explain to his foreman just how certain records are to be kept, or life-tests carried out, and the foreman starts off with the initial entries carefully made, vowing that they shall be followed up with unceasing vigilance. The manager departs feeling that he will get a reliable comparison between Jones's and Robinson's wheels at last, but, when he calls for a report in due season, he finds that a couple of years have been wasted, because the wheels which were in car 42 are now in 160, and may have run under some other cars in between. Then the manager delivers an address to the foreman and determines that, in future, he will exercise a little more personal supervision of the details affecting such tests.

It is weary work training some foremen to become statisticians and commercial testers, and in some cases it is impossible, but no foreman is worth keeping if his mind cannot be moulded to method.

ORLING-ARMSTRONG ELECTRO-CAPILLARY RECORDER.

WE were recently favoured with an opportunity of inspecting an apparatus of remarkably interesting properties, at the offices of the General International Wireless Telegraph and Telephone Co., Ltd., namely, the Orling-Armstrong electro-capillary recorder. Our readers will remember that in December, 1901, we gave an illustrated description of a very delicate electro-capillary relay which had been devised by Messrs. Armstrong & Orling, of which we said that it might conceivably "be made an exceedingly sensitive receiver, more so even than the telephone." In the interval which has elapsed since that date, a very considerable advance has been made towards the perfecting of the instrument. The receiver has been so far simplified that the essential parts could be made for a few pence, yet possessing a very high sensibility, and it has at the same time been adapted to record, by photographic means, the signals received. The following brief account of the apparatus may, therefore, be of interest :—

Fig. 1 shows in section the working parts of one form of the recorder. As in the relay above-mentioned, the principle of the device is the same as that of Lippmann's electrometer,

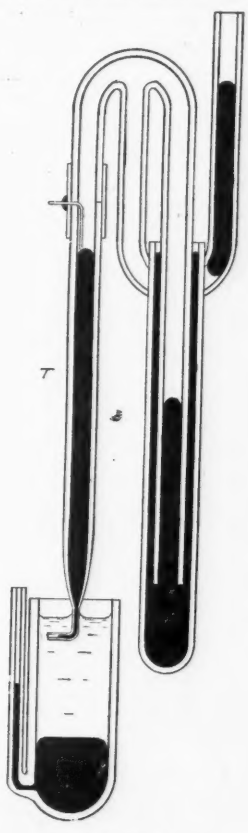


FIG. 1.

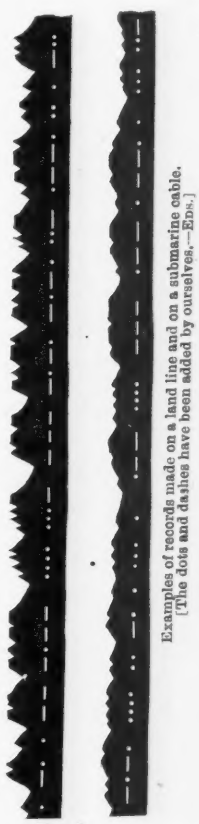


FIG 2.

Examples of records made on a land line and on a submarine cable. [The dots and dashes have been added by ourselves.—EDS.]

its action depending upon the change of surface tension at the bounding surface between mercury and dilute sulphuric acid when a difference of potential is established between the two media. In the relay this change was utilised to cause mercury to flow out of a capillary tube, actuating a mechanical device directly, or closing an electric circuit which produced a similar result. In the recorder, however, the mercury never flows out of the capillary tube, but rises and falls in the latter according to the sense of the potential difference.

In fig. 1, T is the tube containing the mercury column, and ends in a fine capillary extension under the surface of dilute sulphuric acid ; the capillary portion is bent at right angles to the tube, and the bounding surface between the two liquids is at the middle of the length of the horizontal portion. Connection is made with the mercury by means of a platinum wire fused into the glass, and with the electrolyte

by means of a quantity of mercury, as shown. A difference of potential being established between the terminals, the end of the fine thread of mercury either approaches or recedes from the aperture of the tube, according to the polarity employed, and by means of a suitable projection apparatus the magnified image of the thread is thrown upon a travelling sensitised tape, producing records of the type shown in fig. 2. The additional tubes shown in fig. 1 are intended merely to adjust the position of the mercury thread in the capillary tube, and we may mention that the same object was achieved in a far simpler manner in the apparatus which we inspected. The adjustment once made remains constant, the end of the thread coming back to the zero position with certainty, directly the P D. is removed. Fig. 3 shows a complete recorder, including the projection apparatus, a light-tight box enclosing the sensitised tape, and a motor to drive the latter. A Nernst lamp now replaces the arc lamp illustrated, and instead of the light-proof box being used, the tape may be exposed through a narrow adjustable slit in the wall of an ordinary dark room, so that the tape can be developed and fixed continuously as it receives the photographic impression; these modifications are, in fact, in use at the company's offices (Moorgate Station Chambers, E.C.).

Turning to the practical applications of the device, we must premise that practically no current flows *through* it, the action being due to polarisation at the surface of the electrolyte; hence an infinitesimal amount of power is required for its operation, and it is exceedingly sensitive. One-third of a volt, working through a megohm, amply sufficed on the occasion of our visit. Herein lies its peculiar suitability for use as a submarine cable recorder, fulfilling the functions of the siphon recorder, and the inventors claim that it can be worked at least twice as fast as the latter; moreover, we are informed that it has been so operated on Atlantic cables, and in addition that it has been used on the land lines (mixed underground and overhead) of the Post Office from London *viâ* Glasgow and Edinburgh to London, recording messages transmitted by the Wheatstone transmitter at the rate of 360 words per minute. We need not dwell upon the extensive field open to such an apparatus in this direction. It is worth mentioning that owing to the great sensitiveness of the instrument, a very low battery power is required, even with submarine cables, and we are assured that communication can be maintained even when the cable is severed, by induction across the gap. Fig. 4 shows a recorder arranged for receiving cable signals. The recorder is also applicable to wireless telegraphy, being used in series with an ordinary coherer; and the special feature of this application is the fact that when practically no current is allowed to pass through the coherer, as in this case, the latter is self-decohering. Thus Morse signals can be recorded as easily as in telegraphing through wires.

Communication has been effected, we are told, between London and New York without any intermediate relay or repetition of the messages, by means of the instrument. A large number of recorders can be connected in parallel without detriment to their efficient working, and the rapidity with which the device responds to electrical impulses appears to be remarkably great; a tuning-fork, for example, sounding into a telephone receiver connected with a recorder, suffices to produce a record of its beats, and this suggests other applications for the instrument, besides demonstrating its capabilities. We trust that by its means important improvements may be effected in telegraphy of all descriptions.

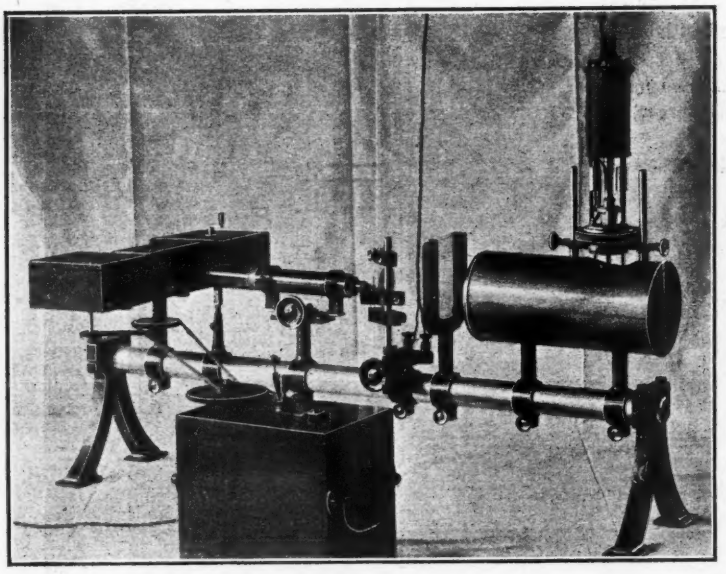


FIG. 3.

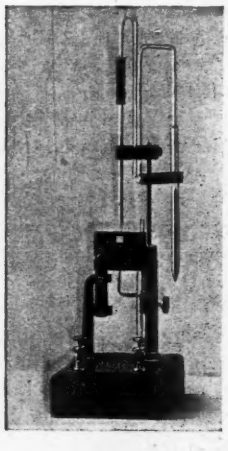


FIG. 4.

SIMPLE STORIES.

BY "INNOCENS."

NOTE.—One of the Metropolitan Supply Companies laid its trunk mains under the towing path of a canal. These were, on one occasion, located as herein described.

VII.—L'ENFER: A STUDY IN THE FRENCH MANNER.

IT is night. The moon swims deliciously in the billowy cloudlets like a nymph disporting herself in the caresses of the ocean. Recollect to yourselves, *mes amis*, the advertisement of Messieurs Pears. On such a night, what fond desires, what sweet suggestions, envelop one's mind!

Allons donc!

The barge, the *Weary Wolloper*, glides softly to her moorings in the canal bank. The glamour, the essence of poetry pervades the scene. Materialism is banished with the crude daylight, and everything, *mes frères*, is most favourable for us to expend our sentimentality in the most lavish manner. As we do.

The bargee springs gallantly ashore and prepares to make fast his boat. What grace! What agility! *Ma foi*, what a man! He thinks of home, of wife and family. Of the supper that awaits him, of Irish stew with many onions. Of the *petite tasse* which he calls a "tonique." He whistles gaily, "Good-bye, Dolly, I must leave you," as he poises the heavy bar of iron above his head, ready to plant it in the towing path, a safe hold for his boat. Honest man!

In the distance is heard the thud of the engines of the electric light station. Under the towing path—ah, the perfidiousness, the subtlety of electricity, my cherished ones—lie the cables electriques of Villesdenne!

With a sigh of satisfaction at the completion of another

day's labour, the bargee dashes the rod of iron into the quivering bosom of the earth.

Sacré bleu! Mille tonnerres! Ma foi, quelle horreur! How shall I commence to say to you a history of what now occurs! It is as though the elements *de l'enfer* are suddenly let loose. The light flares! The ground rocks! Devastation, confusion, encircle the prostrated bargee. The heat is intense. The bar of iron is volatilised instantaneously! In the distance the engines of the electric light station groan at their unaccustomed labour. Agitation, consternation, reign over all. Figure to yourselves the scene!

With a last despairing effort the bargee recollects himself. With a convulsive bound he leaps into the canal. There it is uncomfortably wet, but not so hot. He is nearly drowned, for he sticks in the mud. Yet he prefers above all to stay there, for his confidence in the towing path is shaken. He is ultimately rescued on the end of a barge pole and is given a tonique—two—three—by his condoling companions.

In the distance the engines of the electric light station have shut down. For it is of no utility for them to run on a dead short consisting of a bargee's bar.

ELECTRIC TIDES AND EARTH CURRENTS.

By W. H. SHARP.

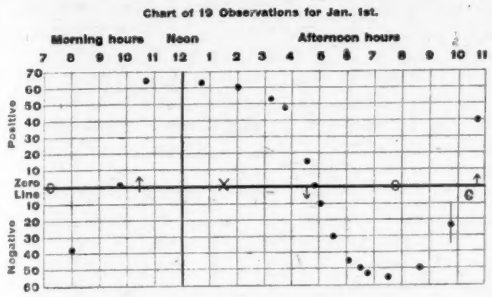
So far as I am aware, there has been no satisfactory or conclusive result of the observations and investigations made with a view to the determination of the origin and laws of earth currents. I propose herein to state some of the results of my researches thereon, and am under the belief that they will be found to have an importance not only as regards earth currents, but also as regards other branches of scientific inquiry.

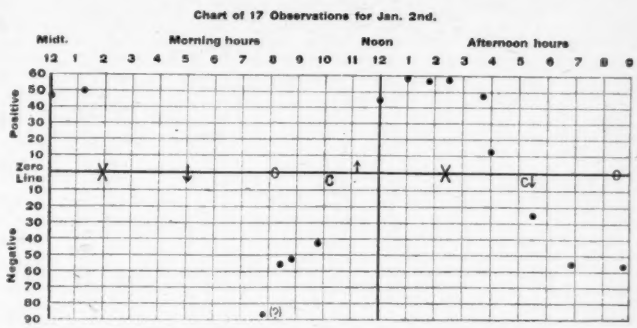
Seven years ago I made an exhaustive search, in order to ascertain what was known up to that time as to earth currents. I have not found leisure to continue that special search during the last seven years, but I have reason to believe that little, if any, important advance has been made during that interval.

After examination of earth-current literature in general, I arrived at certain conclusions, which, instead of attempting to illustrate by experiments or records of observations made by myself, I will illustrate, by using the published record of galvanometer readings of earth currents in the North Sea cable, given in the *Telegraphic Journal*, April 1st, 1878, p. 138.

As I have not, and never had, any knowledge of that cable, or of the observers, beyond such as may be obtained from reading that record, I shall use it, as affording absolutely independent evidence for my purpose. That record refers particularly to five days (1st to 6th) in January, of a year not expressly stated, and I will reduce its figures into five scaled charts, having zero reference and time lines, and showing positive and negative deflections of the galvanometer needle in degrees respectively above and below that zero reference line. There are in all 83 observations recorded, but 13 are indefinite. Changes of direction I have marked with the letter C in the five charts when the observation was indefinite; and such observations as depend upon stated extremes of the needle's swing, I have marked with a line indicating the amplitude, and have shown its mean point. Certainly such mean would not agree in magnitude with the needle's equivalent position of rest under the then active deflecting force, though it would agree as regards time.

Clearly the points in those charts belong to a continuous curve of peculiar flexure. I will now arrange those five charts as five separate witnesses in definite order upon one continuous time line in one general chart, so as to show their relation with each other, and also with the time intervals intervening. I reject the indefinite zero observations, and two long swings (January 5th), and connect the 70 remaining points by straight lines, so as to outline five portions of one general curve determined by 68 definite observations, and affected by two indefinite readings at 9.46 p.m., January 1st, and 7.50 a.m., January 2nd. For economy of space, the scale is proportionally reduced in this general chart, but the evidence is in nowise altered.





Electric Tides and Earth Currents—Charts Nos. 1 and 2.

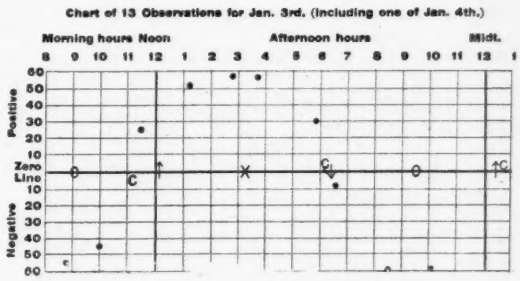


Chart No. 3.

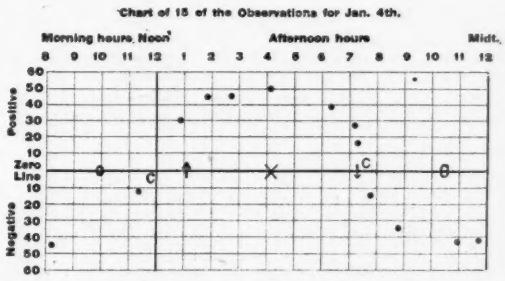
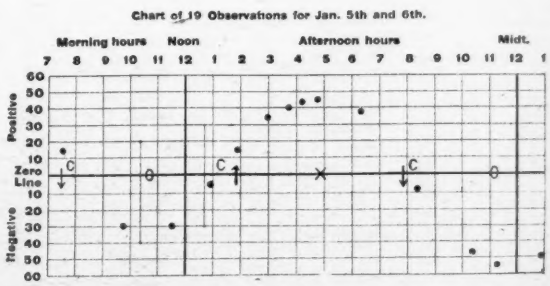


Chart No. 4.



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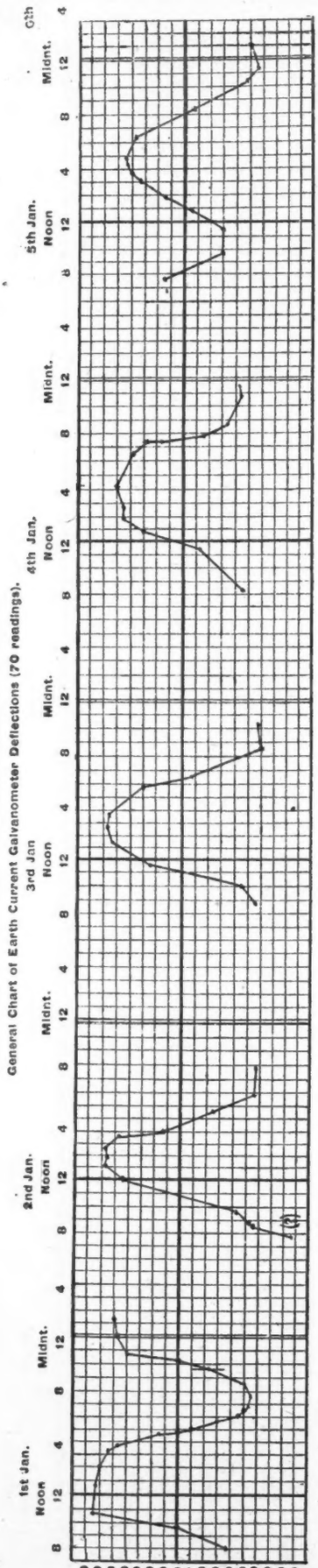


This general chart shows clearly that positive maxima were produced about noon, January 1st, and about midnight succeeding thereto, according to the record; but that negative maxima were produced about noon, January 5th, and about midnight following. If the sun's influence alone caused all those maxima, why had the electricity changed its sign from positive to negative; for instance, from noon, January 1st, to noon, January 5th? It is incredible that the sun's influence had so changed, and this will be more obvious as the general chart is analysed. In particular, it may be noted that if the sun alone could produce a positive deflection of 65 divisions about noon, January 1st, it is significant that at noon, January 4th, it apparently was unable to produce either a positive or a negative maximum, and was seemingly out of action then as regards electrical influence in the case reported.

No! The sun's influence alone does not suffice to account for the changes in magnitude and direction of earth currents of electricity in this instance, or in thousands of others noticed by various observers, British and foreign.

I had myself obtained experimental evidence years ago of the moon's influence upon certain delicate and refined apparatus, and I shall now use this chart to prove the influence of the moon in connection with the production of earth currents of electricity.

This general chart shows that the corresponding maxima tend to advance day by day so as to occur about an hour later each day than on the day preceding. They seem to recur at regular intervals of about 25 hours, and to have a decreased value on each recurrence during the period January 1st to 6th under discussion. If the recurrence had been at about 24-hour intervals, it would have been reasonable to suppose that the sun by its recurrent daily positions with reference to a given point on the earth, brought about the regular recurrence of the observed earth current maxima. The interval observed is nearer to that of the moon's mean daily meridional transits, viz., 24 h. 48 m. 44 s. This is only 11 m. 16 s. short of 25 hours, and the difference is less than 1 per cent. therefrom.

Applying by scale measurement that lunar transit interval —the lunar day—to this chart it agrees approximately with the time intervals between similar portions of corresponding wave crests and troughs therein. The lunar semi-diurnal mean interval, viz., 12 h. 24 m. 22 s., measures approximately the time occupied in the double oscillation of the galvanometer needle recorded on January 1st, if the definitely ascertained zero at 9.40 a.m. be taken as the point of departure on the zero time line.

We have in these charts absolutely independent evidence, 26 years old, collected and published apparently without the slightest knowledge or suggestion of any actual or possible connection with a lunar or aqueous tidal interval, evidence which, I say, when rightly understood, speaks clearly and unmistakably of a lunar interval and influence, as its dominant characteristics. But that is not all, for if you will but note how clearly the positive day maxima decrease as they are produced at times further from Solar mean noon, it must be obvious that a Solar interval and influence are secondary characteristics shown also in that general chart.

Let us note the positions of the places connected by the cable used in this case. Its western end is near Peterhead, which is in 57° 30′ 10″ N. lat., and 1° 46′ 20″ W. long. Its eastern end is near Egersund, which is in 58° 26′ N. lat., and 5° 59′ E. long.

It is so situated that the aqueous tidal waves from the Atlantic, after dividing and bending round the north of the British Isles, pass across that cable's length in their progress southwards down the North Sea. And it is important to observe that the local principal channel runs down the western side of that North Sea, so the aqueous tidal flow is approximately greatest in the vicinity of the prime meridian. Therefore, although the aqueous tidal waves, at periods about new and full moon, arrive about 20 minutes sooner over the eastern extremity of that cable than they do over the western end, I shall be entitled hereinafter to consider the aqueous tidal conditions, and prime meridian, near the western end of that cable as sufficiently representative for my purpose, of those of the locality of the cable as a whole, because the principal aqueous tidal flow to which it is exposed is a transverse flow across it, near its western end.

I submit that I have already established a strong *primâ facie* case in support of my contention that the curve outlined by these 70 independent observations proves their luni-solar origin or connection. And it is none the less true, even though the proximate cause may have been aqueous tidal friction, or pressure, or other aqueous tidal influence, inasmuch as it is long and well known that luni-solar influence originates, or is connected with, the aqueous tidal currents.

(To be concluded.)

INSTITUTION OF ELECTRICAL ENGINEERS.

MOTOR-STARTING SWITCHES AND RESISTANCES.

By F. O. Hunt, Associate Member.

(*Abstract of Paper read in Birmingham on Wednesday, May 18th*, 1904.)

Starting switches as a class of apparatus have been, until comparatively recently, very much neglected by electrical engineers, and yet every one will admit that the life of the most vital part of the continuous-current motor—the commutator—depends very considerably on the character of the apparatus used for starting the motor, and on the way in which that apparatus is used.

By far the most extended treatment of the subject is that given by Mr. A. E. Gott, in a paper read before the Newcastle Section of this Institution in January, 1902. In a paper read before this Section last year, Mr. A. H. Bate aptly referred to the "starting switch" as a "necessary evil." The charge is admitted, but so long as the apparatus is "necessary," it is just as well to make the evil characteristics as few and as small as possible.

It is well known that in a general way the sub-division of a starting resistance should follow a geometric law, and yet large numbers of starters are still sold, which do not in any way approach the correct sub-division.

The quantities which require special attention are, the current increment at the instant of passing from one stud to the next, the "sparking voltage" between successive studs, and the connection of these with the constant ratio of the Geometric Progression and the figure representing the fraction of the whole armature-input which is lost in the armature windings.

It has been shown in the papers previously referred to, that, if a limitation on the increment of current-demand is fixed by the suppliers, the current curve in starting up the motor must be of the form shown in fig. 1; and that to obtain a current-fluctuation over a constant range in the "saw-tooth" portion of the curve, the resistances connected to those studs of the starter must be arranged in a descending geometric progression.

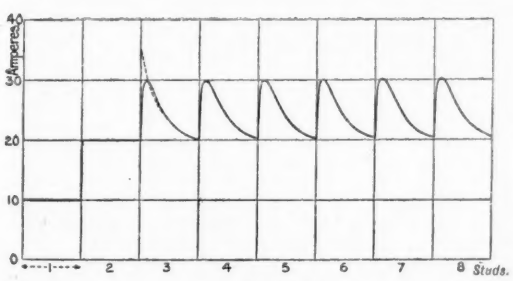


Fig. 1.

List of Symbols.

- V = Volts of supply.
- P = Power of motor in H.P.
- η = Efficiency of the motor, stated as a decimal.
- λ = $C^2 R$ loss in armature, stated as a decimal (*i.e.*, the fraction of the armature-input at full load, which is lost in the armature-conductors).
- n = Constant in the G.P.
- s = Number of contact studs in the speeding-up portion of the switch.
- e_1, e_2 = Final back E.M.F. of armature with switch on successive studs.
- C_s = Steady value of current on any of the speeding-up studs.
- C_i = Current increment on passing from one stud to the next.
- r_1, r_2, r_3 = Resistance in circuit when switch-blade is on successive speeding studs.

Assuming that the law of geometric division on the speeding-up studs is established, and that we are considering a case in which the torque required from the motor is approximately the same at all speeds, we have for the first term of the G.P.:—

$$\frac{V}{\frac{P \times 746}{\eta V}} = \frac{\eta V^2}{P \times 746},$$

and for the last term (*i.e.*, the resistance of the armature)—

$$\frac{V\lambda}{\frac{P \times 746}{\eta V}} = \frac{\eta V^2 \lambda}{P \times 746}.$$

But the ratio $\frac{\text{last term}}{\text{first term}} = n^{(s-1)}$, $\therefore n^{(s-1)} = \lambda$ . . . . . (1.)

or, $$s = 1 + \frac{\log \lambda}{\log n}. \quad . \quad . \quad . \quad . \quad . \quad (2.)$$

It may be noted in passing that λ is a quantity which has only a comparatively small range of variation. From 5 H.P. to 50 H.P., at ordinary speeds, this factor varies from about 0·04 to 0·02.

Now consider the nature of the current increments during the speeding up of the motor. To obtain the true values of these would be an exceedingly complicated matter, owing to the effect of self-induction in the armature; but we can quite simply obtain an expression for their utmost limiting value on the assumption of no self-induction in the armature, and get at the actual relation between this and the true effective value by direct experiment.

r_1 = Resistance in circuit when switch is on first speeding stud.

$r_2 = n r_1$ = Resistance in circuit when switch is on second speeding stud.

Evidently the limiting value of current, on blade touching second stud, $C_2 = \frac{V - e_1}{n r_1}$.

But, $C_s = \frac{V - e_1}{r_1}$, $\therefore \frac{C_s}{C_2} = n$, or $C_2 = \frac{C_s}{n}$.

Therefore current increment $C_2 - C_s = \frac{C_s}{n} - C_s$, $\therefore C_i = \frac{C_s(1-n)}{n}$

Now, since the current increment is often specified, we may write

$$n = \frac{C_s}{C_s + C_i} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Therefore also from (2), $$s = 1 + \frac{\log \lambda}{\log\left(\frac{C_s}{C_s + C_i}\right)} \quad . \quad . \quad . \quad . \quad (4)$$

This gives at once a means of determining the number of studs to fulfil a given specification, provided we have been able to experimentally determine the proportion existing between the calculated increment and the actual value as modified by the inductance of the armature, for the kind of load with which the motor is to be used. Thus, supposing this ratio to be, say, 7 to 5, when a 5-ampere limit is imposed, a motor giving 25 H.P. at about 850 r.p.m. on 440 volts would require about 28 studs in the speeding-up portion alone.

There remains another quantity which, while not affecting the working of the starter at any particular time, has a very serious effect upon the lasting capabilities of the switch, viz., the "sparking voltage" between studs.

This quantity is evidently the drop of volts which takes place over the section of resistance between the two studs concerned, when the resistance carries the current normal to it before the short-circuit takes place.

In the speeding-up portion these are evidently—

$$C_s(r_1 - n r_1) = C_s r_1 (1 - n)$$
$$C_s(n r_1 - n^2 r_1) = C_s r_1 (1 - n) n$$
$$C_s r_1 (1 - n) n^2, \text{ \&c.}$$

Obviously, since n is fractional, the worst condition is that expressed by the first term, and since $C_s r_1$ = the supply voltage, it is easy to see which is the earliest term which will comply with a given limit of sparking voltage. Up to that point, of course, the resistance sections must be made equal to this section, thus increasing the number of studs necessary for the accommodation of the required total value.

If full-load current is not allowed to pass through the motor, with the switch-blade on the first contact stud, there still remains for consideration the question of how the additional resistance shall be sub-divided. Obviously, if we only have to comply with a current-increment limit, the simplest plan is to divide it equally so as to give the limiting increment at each contact; but here again a consideration of the sparking voltage compels an increase in the number of studs.

Calling these initial studs a, b, c, &c., and using the letters as subscripts to indicate the currents, resistances, and sparking voltages occurring at those studs, we have for sparking or "flashing voltage" on stud b—

$$f_b = C_a r_a - C_a r_b, \qquad f_c = C_b r_b - C_b r_c,$$
$$V = C_a r_a = C_b r_b,$$
$$\therefore f_b = V\left(1 - \frac{r_b}{r_a}\right) \text{ and } f_c = V\left(1 - \frac{r_c}{r_b}\right)$$
$$\therefore \frac{r_b}{r_a} = \frac{r_c}{r_b}.$$

That is r_a, r_b, r_c, &c., are in G.P. between the limits $\frac{V}{C_a}$ and $\frac{V}{C_s}$.

The constant factor $= \frac{V - f}{V}$ . . . . . (5.)

It is obvious from the foregoing considerations that the usual specification of current-increment is often more or less an absurdity. Not that the writer would suggest that no limit should be placed on the current-increment, but that, seeing it can be shown from the above expressions that no commercial starter has sufficient studs to comply with the requirements frequently specified, and as ordinary commercial starters are in use on mains for which these strict limits are supposed to be imposed, it is evident that the current-increment limits stated are often much lower than is really necessary.

Evidently also if a limit is placed on the current-increment, a minimum limit should also be placed on the time taken to complete the operation of bringing the motor up to full speed.

It would also appear to be likely to lead to greater satisfaction on the part of the users, if specifications were made to include a limit on the sparking voltage.

The following quotation from a recent starter specification will serve as an illustration of the points in question:—

"The switch shall not have less than 8 contacts; . . . when the switch lever is placed on the first contact the instantaneous current flowing in the motor circuit shall not be greater than 5 amperes . . . On each successive contact each increase of current shall not be more than 5 amperes."

This specification applied to motors up to 25 H.P. on 440 volts, and contained no reference whatever to sparking voltage.

Even neglecting sparking voltage, the switch for 25 H.P. would require about 37 studs.

With regard to expression (V), since the sparking voltage is usually only troublesome when the contact-maker is drawn back, the increase in the number of studs might be avoided by the construction of a switch, on which any retractile movement of the starter contact should cause the circuit-breaking member of the switch to come into action. This could also be made to yield a further assistance by allowing the resistance winding to be made up in an inductive form, and so make that property assist in reducing the current peaks during the speeding-up; but so far as the writer is aware no maker has, as yet, adopted any such device.

Rating of Resistances.

This question was raised in the paper read by Mr. A. H. Bate before this Section last year, and in the discussion the present writer made the suggestion that the rating of resistances should be based on the idea of a factor of safety as in other mechanical ratings. The most suitable way of applying the notion appeared, at first sight, to be as a time factor, and it was with a view of following this up that this investigation was undertaken.

It was assumed at the outset that the temperature of "just-visible-red" is that at which destruction of the resistance-material really begins. Moreover, it happens that the instant when a wire reaches this condition can be determined with considerable accuracy, thus making the experiments fairly reliable.

The wire under test, as an open coil, was supported by its ends in an absolutely dark cupboard, and readings were taken of the time during which a certain current had to flow through the wire in order to raise its temperature from that of the atmosphere (say 12° C.) to the temperature of "just-visible-red" (say 500° C.).

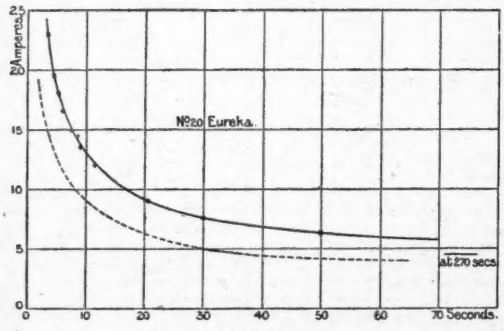


Fig. 2.

A curve obtained in this way is shown in fig. 2. A glance at this curve shows at once that a time factor is not really the most satisfactory basis on which to carry out the rating of wires for starters.

Supposing the normal use of a starter is to be 3 seconds per stud, with a total of 30 seconds for the whole process, it is far more likely that the first step might be subjected to use for 9 seconds, than that the last would be kept in circuit for 1½ minutes. Further, the danger of breakdown by such exceeding of the rated use is far greater in the early steps than in the later ones.

Obviously it is on the earlier steps of the starter that close cutting of the rating is the most important, from the point of view of economy in manufacture. For the rating of these steps, evidently a factor based on the sub-division of the "ultimate" current value is much nearer what is required, but on the later steps this tends to make the wires much heavier than is really necessary. The only satisfactory course appears to be a compromise between the two. Fortunately this is easily done by means of a curve such as that shown dotted in fig. 2.

Curves such as these having been obtained for all necessary sizes of wire, under the same conditions as those present in the starter, it is possible to lay out the starter windings with some definite idea of the same degree of safety being obtained in all parts of it. A table of a few representative values is appended.

Experiment shows that absorption type resistances follow a similar law, but of course having different constants for the same size of wire.

From the foregoing it would appear that a thoroughly satisfactory specification for starters should take into account the difference in the conditions existing for the earlier and later steps, a simple statement of the length of time during which a certain overload current shall be carried not being sufficient, owing to the fact that it involves more expense than is necessary at one end, even while giving barely adequate protection at the other.

Even then in fixing the time limits per stud and over the whole operation the character of the load to be driven must be taken into account, as it may make an enormous difference in the time required between stud and stud on the speeding-up portion of the starter.

It was originally intended to follow up the experimental evidence of fig. 2 by an analytical investigation, with a view to substituting a true theoretical law for the type of empirical one obtained for this curve; so that all sizes of wire would be taken into account in the one expression. Time and circumstances have not allowed of this being carried to completion.

In conclusion, the author wishes to acknowledge his indebtedness to his former assistant, Mr. J. Allen, for many valuable suggestions, and to Mr. J. K. Catterson-Smith for his very kind and able assistance on a portion of the experimental work.

Table I.

S.W.G.	12	16	20
Time in seconds.			
2	124	55·5	17·6
4	114	47·6	15·0
6	101	39	11·6
8	87·5	33·1	10·0
10	77·5	30·5	9
14	66·5	26 3	7 7
20	56·2	21·7	6·4
30	45·5	17·8	5·15
50	35·3	13·8	4·22

Discussion.

The Chairman (Mr. J. C. Vaudrey) expressed the appreciation of the meeting of the ability with which the subject had been treated, and went on to say that a good up-to-date starting switch had long been wanted; simplicity, strength and reasonable price were essential.

Mr. Bornand (communicated): The author's remark that it might be advantageous to use inductive resistances to reduce the current peaks during the speeding-up was at first sight a very tempting one. Still, there were many difficulties which prevented the manufacturers from following up this idea. The important questions of space and cooling prevented the arrangement of the resistance coils in such a way as to allow an appreciable amount of inductive effect. There was a certain make of starters where flat strips were wound on iron cores with asbestos insulation, and there some small inductive effect had been noticed.

H. W. W. Dix said it was very desirable that some simple method of specifying a starter should be evolved, but he was afraid if they were going to build a specification to please Mr. Hunt, it would be a very complicated affair. He had found, in designing standard starters not made to any particular specification, that if they were designed for about 0·6 full load, it made the rushes of current at each step reasonable, whether you started the motor at full load, or say, down to a quarter-load. It might be noted that the formula in the paper was for starting against full load, and that its value must, of course, be varied for starting against loads other than this. He thought sparking could be overcome with only a moderate number of contacts by good mechanical design. In many types of starters, especially those with flat contacts and in which the arm had to slide back under the influence of a spring, it was very difficult to get a really tight contact, and it was also difficult to move from one contact to the other without sparking. It had occurred to him that the drum principle was a good one, enabling them to secure tight contacts, and he had designed a switch recently on those lines, a model of which he had brought for the inspection of members. He thought Mr. Hunt's figures in Table 1 and his curve in fig. 2 ought to be very valuable indeed to designers. To obtain really good results with starters in actual practice, the sound mechanical design of the starting switch was at least as important as the correct grading of the starting resistances, and it would have been an advantage if the author of the paper had dealt with the starter from the mechanical point of view. In a starter designed to give full protection both to itself and the motor it controlled, the following were the main conditions it must fulfil. It must—

1. Prevent sudden switching on.
2. Switch off if the supply were interrupted.
3. Switch off if an overload occured.
4. Prevent the resistance from being left in circuit.
5. Prevent arcing on the contacts.
6. In shunt-wound motors, break the shunt circuit without risk of damage.
7. Be capable of being switched off instantaneously.
8. Have substantial fireproof resistances.
9. Be completely enclosed in a strong earthed metal case.

In designing a mechanism to meet these conditions in the writer's experience, the following mechanical points should be observed:—

1. The utmost simplicity must be aimed at.
2. All the mechanism should be accessible on removing the switch cover.
3. The moving contact must make a tight, and preferably an independent contact, with the fixed contacts.
4. The pressure forcing the moving contact against the fixed contacts should be directly balanced.
5. No long range springs must be used.
6. Solid moving contact blocks should be used, as they stood hard usage better than laminated brushes.

In switches of the ordinary radial type employing a spring, often of considerable range, to switch from the "on" to the "off" position when the hold-on magnet was demagnetised, it was practically impossible to obtain a tight contact between the blocks held in the radial arm and the fixed contacts. The spring, besides being liable to break, often failed to switch completely off, either on account of the spring weakening, or through burns on the contacts impeding the free motion of the radial arm. Fig. 3 showed the principle of the switch exhibited at the meeting. It was of a simplified drum type, the drum being worm-shaped and geared with

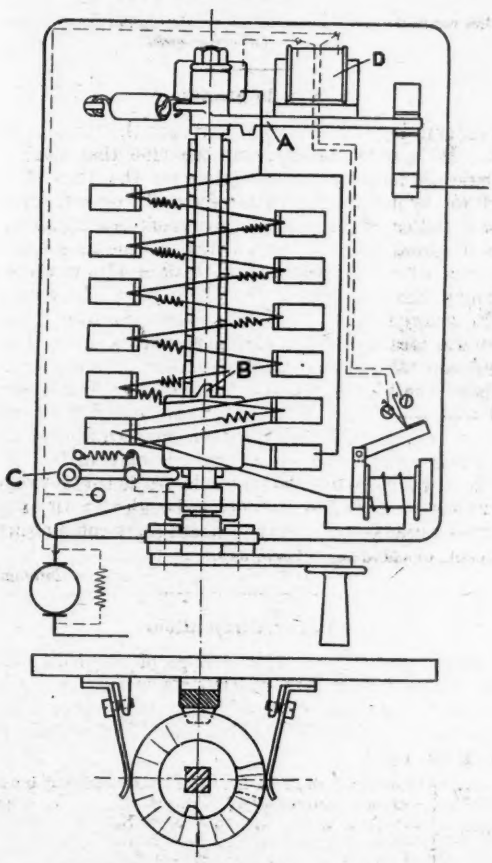


FIG. 3.

a rack to give the slow motion. The circuit breaker A, which was provided with a magnetic blow-out and made and broke the circuit, could only be closed with all the resistance in circuit, this being effected by winding the drum into "all in" position, until the lug B engaged with the lever A. The resistance was prevented from being left in circuit by the auxiliary switch C, which always short-circuited D unless it was held off by hand or until the motor was brought up to full speed, when the drum held it in the off position. While starting, C was held off by the left hand until all the resistance was cut out, but should the operator leave any of the resistance in circuit, the motor stopped directly he released C. This auxiliary switch was a weak point in the design, but practical experience with it had demonstrated that it was quite simple to use, and as it enabled condition No. A to be met with a simple mechanism free from large range springs, it was considered to be quite justifiable. The design has been tested on a 50-H.P. 460-volt motor starting against full load, with very satisfactory results, the switch being found easy to handle and free from burning at any of the contacts. The principle of the switch could be applied to switches without automatic features, and to switches for slip-ring induction motors, two rows of contacts with consecutive switching of the phases being used for three-phase motors.

(*To be concluded.*)

A PLEA FOR CONSISTENCY.

[COMMUNICATED.]

THE old saying that "the strength of a chain is that of its weakest link," is so absolutely true, that it can scarcely be too often repeated. It has probably never been more strikingly exemplified than in connection with matters electrical.

Here some sort of fatalism appears to dog the footsteps of the engineer, causing him to spoil an otherwise carefully thought out scheme by introducing a weak link, which is, in course of time, likely to lead to disaster.

Take, for instance, the case of many central station switchboards, and the weak link will soon be in evidence in the shape of a mass of highly inflammable cables stowed away at the back.

Anything more inconsistent with safety it would be difficult to imagine, and the large number of disastrous fires which have resulted from this one cause should have long since brought about absolute prohibition of such an arrangement.

The remedy should have been obvious to practical men from the first, and yet fireproof cables are but slowly receiving the recognition they deserve.

Another weak link in the switchboard scheme is frequently the type of fuses adopted.

Most elaborate precautions are taken to separate + and − poles and to render it impossible to get a short circuit, the current carrying apparatus is sometimes even isolated in cell-like structures, and yet the destruction of the whole board is brought about by the use of a fuse of an obsolete and highly dangerous character.

The extraordinary point in connection with the above, is the fact that fuses of absolutely safe construction, and on which an arc cannot possibly form, are readily obtainable.

Only a few days since the writer was looking at a central station switchboard and found it fitted with a number of exposed fuses which simply consisted of a strip of fusible metal held between two binding posts.

The writer observed from the instruments that one of these fuses was carrying 250 H.P., and that it was comfortably warm when tested by the bare hand.

The switchboard attendant stated that he had never known one of these fuses to operate, as they relied upon the circuit breakers in series with them, which were set at a lower current than would melt the fuse. This is, unfortunately, exactly how accidents happen; one unhappy day the circuit breaker sticks from some cause, and the wretched apology for a fuse being forced into action promptly arcs over, and immense damage may result.

Turning from switchboards, we find a very weak link in many motor installations. A motor-driven piece of machinery is constantly found to be governed by a ridiculous piece of apparatus termed a starting switch, probably of the cheapest foreign make, the highly important resistance portion whereof being conspicuous by its absence. The plain fact is that the carrying capacity of these resistances is cut so fine, that a slight increase in the starting current causes destruction to the coils and a stoppage of machinery.

LEGAL.

MANCHESTER TRAMWAYS CO. *v.* THE ASHTON-UNDER-LYNE CORPORATION.

MR. JUSTICE BIGHAM, on 7th inst, gave judgement in the case of the Manchester Carriage and Tramways Co., Ltd., *v.* the Mayor and Corporation of Ashton-under-Lyne.

When the company's undertaking was taken over, the matter went to an arbitrator. Among the points to be considered was whether the Corporation were bound to take over the Ashton depôt with trams, &c., as a whole, or only such portion of it as they desired for their own service, and also whether the Corporation were liable to pay for certain Parliamentary expenses incurred in promoting the concern.

MR. JUSTICE BIGHAM, in his judgement, now said he thought the Corporation must take over the Ashton depôt and its contents. As to the expenses, not only the costs of obtaining powers to construct, but also the costs of obtaining powers to work the line ought to be taken into account. All such expenditure was cost of construction, and this view was supported by the fact that the arbitrator had found it impossible to sever the costs of construction and the costs of powers for working.

Judgement would be for the company for £13,970, £8,750 and £3,107—the Corporation to pay the costs of the proceedings before that Court.—*Manchester Daily Dispatch.*

BRIGGS *v.* PARTINGTON.

AT the Salford Hundred Court of Record on 9th inst, says the *Manchester Guardian*, damages for misrepresentation and breach of contract, were claimed by Henry Briggs, trading as a glass cutter and polisher in Ancoats, under the style of "Hy. Briggs & Co.," from W. E. Partington & Co., trading as "Partington & Co.," electrical fitters, Levenshulme. MR. WHARTON appeared for the plaintiff, and MR. SPENCER HOGG for the defendant.

The plaintiff's case was, that the defendant induced him to replace steam as the motive power in his works, with electricity. He agreed to take two motors, of 13 and 5 H.P. respectively, from

a company recommended by the defendant. When the motors had been fixed, it was found that the one of 13 H.P. was incapable of doing the work which, it was alleged, the defendant had represented it would do. In the meanwhile the plaintiff had agreed to sell his steam engine and boiler. When he found that the motor would not do its work he had to make terms with the purchaser of the boiler and engine and have the old means of power reinstated. It was also claimed that the plaintiff had suffered loss by reason of the failure of the defendant to do the wiring necessary to connect the motor with the Corporation's electric cables within the stipulated time.

It was admitted by the defendant that he received a commission on the sale of the motors. It was denied, however, that the defendant had made any representation as to the amount of work the motor would do. The agreement to take the motor was made by the plaintiff with a representative of the makers. The defendant considered that his contract was completed when he had done the wiring and seen the motor running "light," or without connection with the gearing which worked the machinery. In this condition, said the defendant, the motor ran satisfactorily. As to the allegation that there had been a breach of contract in respect of the time taken to complete the work, the defendant said that the plaintiff had, by negligence, obstructed the progress of the work. The defendant also contended that the motor would have been capable of doing the work had the shafting been in good condition.

The jury found for the plaintiff for the amount claimed (£43), and for the defendant on a counterclaim (£12 18s. 11d.). The counterclaim was for work done by the defendant.

SCHONER *v.* ROSE & CO.

AT the Leeds County Court, on the 10th inst., before His Honour Judge Greenhow, Mr. Theodore Schoner, electrical engineer of Leeds, brought an action against Messrs. Rose & Co., provision merchants, claiming £30 for work done and goods supplied.

On behalf of the defendants, last year, a Mr. Bell requested the plaintiff to supply a 2½-H.P. electric motor to work a refrigerator, but the defendants expressed dissatisfaction with the machine owing to the great noise it made, thus interfering with the comfort of the customers in the adjoining café. The motor was removed by the plaintiff, who returned it to the makers, and a second machine was supplied to the defendants and paid for by them. The present claim was for the first motor, but in cross-examination the plaintiff admitted that he had not paid anything for it, and the makers could not claim anything from him.

Mr. WILLEY, for the plaintiff, then abandoned the action, and judgement was given for the defendants, with costs, his HONOUR making the remark that the plaintiff had evidently been seeking to recover "Moral and intellectual damages." — *Yorkshire Daily Observer.*

PARLIAMENTARY.

ROYAL ASSENT.

The Royal Assent has been given to the following Acts:—
London Electric Lighting Areas Act, 1904.
Post Office Act, 1904.
Weights and Measures Act, 1904.
Wireless Telegraphy Act, 1904.
Post Office (Sites) Act, 1904.
Dundee, Broughty Ferry and District Tramways Order Confirmation Act, 1904.
Electric Lighting Orders Confirmation (No. 2) Act, 1904.
Electric Lighting Orders Confirmation (No. 3) Act, 1904.
Electric Lighting Orders Confirmation (No. 4) Act, 1904.
Electric Lighting Orders Confirmation (No. 6) Act, 1904.
Electric Lighting Orders Confirmation (No. 8) Act, 1904.
Tramways Orders Confirmation (No. 1) Act, 1904.
Tramways Orders Confirmation (No. 2) Act, 1904.
Glasgow Corporation (Tramways, &c.) Order Confirmation Act, 1904.
Ayr Corporation Tramways Order Confirmation Act, 1904.
Portmadoc, Beddgelert and South Snowdon Railway Act, 1904.
London United Tramways Act, 1904.
Torquay Tramways Act, 1904.
Tyneside Tramways and Tramroads Act, 1904.
Holywood Tramways Act, 1904
Lothians Electric Power Act, 1904.
Great Yarmouth Corporation Act, 1904.
Manchester Corporation Tramways Act, 1904.
North Wales Electric Power Act, 1904.
West Riding Tramways Act, 1904.
Radcliffe Tramways and Improvement Act, 1904.
Newcastle-upon-Tyne Corporation Act, 1904.
Saddleworth and Springhead Tramways Act, 1904.
Belfast and North-East Ireland Electricity and Power Gas Act, 1904.
Belfast Corporation (Tramways) Act, 1904.
London County Council (Tramways and Improvements) Act, 1904.
Bristol Tramways (Extensions) Act, 1904.
Loch Leven Water Power (Amendment) Act, 1904.
Middlesbrough, Stockton-on-Tees and Thornaby Tramways Act, 1904.
London County Council (General Powers) Act, 1904.

Wireless Telegraphy Bill.—This Bill was read a third time in the House of Lords on Monday. The Earl of Selborne moved an amendment to Clause 5 (application of the Act to the Channel Islands and the Isle of Man) with the object of deleting words which excepted the substitution for the purposes of the Act of the authorities in the islands for the Board of Trade in respect of the grant of licenses. The words, he explained, were meaningless, and the amendment was consequential on a previous one which had been agreed to. The amendment was agreed to, and the Bill passed. In the Commons on the same day, the Lords' amendments were agreed to.

The Supply of Electricity Bill.—In the House of Lords on 11th inst., the Supply of Electricity Bill was read a third time. On the question that the Bill be passed, Lord Wolverton moved to amend Clause 4 (provisions as to right of local authorities to purchase) by leaving out the following proviso to Sub-sec. (3):—"Provided always that any local authority having power to purchase any part of an undertaking being wholly or partly within the administrative county of London may, subject to the provisions of this section, and to the like consents, transfer such rights to the London County Council." The amendment was agreed to, and the Bill, as amended, was passed.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Simple Stories.

The amusing tale in your last issue has also its tragic side. It is, unfortunately, only too true that some firms strangle all incentive to invention on the part of their employés by not treating them generously, or even decently in the matter of remuneration for profit-bearing ideas. A case in point came to my knowledge some time ago. An employé, whom we will call A, took an idea to the works manager, who pooh-poohed it. A few days afterwards, the works manager told A that he had arranged to pay him for what the idea was worth, and he received a small payment. It subsequently became known that the works manager had patented the idea in his own name at another address, and had sold the rights to a company interested in the manufacture of such goods, and for whom his own company acted as selling agents—for some hundreds of pounds. As the payment was made to A by his employers, it is safe to assume that they were also in the deal, although to what extent is not yet quite clear. This payment represented about one per cent. of the deal. *Verb. sap.*

Nemesis.

Unfair Competition.

I should imagine it is with feelings of bitter disgust that "Electricals" read such advertisements as one appearing in your "Situations Wanted" columns in your issue of August 12th. Here are a few more similar cases, advertised during the last few weeks:—

June 17	10 per cent. bonus on first year's salary offered by No.—	[E. R.
	£10 for a berth offered by No.—E. R.	
July 1	£3 " " " " " No.—E. R.	
	£15 " " " " " No.—E R.	
July 22	£5 " " " " " No.—"S."	
	£15 to £20 for a berth offered by No.—E. R.	
	£50 for a berth offered by No.—E. R.	
Aug. 12	£40 and moderate salary offered by No.—E. R.	

It is becoming a bit "blue," when, leaving alone the fact that it is almost impossible to secure a living wage anywhere, such people as these are ready to even buy their berths. It is disheartening and hard when such, by aid of a deep pocket (enabling bribery) secure berths that are badly needed by those to whom a berth is their living. To scan through the advertisements appearing, and to note the miserable salaries offered, is alone sufficient to make one heartily wish themselves in some other walk of life.

Experience is a necessity (?), but the principle of experience at any cost, is carried too far.

If (as they assuredly are) most of the berths are filled by those anxious to gain experience (minus salary), where are the berths to be found (plus salary) when such experience has been gained?

The general public firmly believe the trade holds out a promise of big salaries and great opportunities of progress (how well some of us know otherwise), consequently a large percentage of the rising generation enter the trade. It is a

pity some able person does not expose the truth in the daily papers, &c.

Until the public are disillusioned of these fallacies, we shall have to submit to the great inrush which is going on, and whilst this inrush lasts the chances of an improved state of things are remote.

From Station Engineers and Kindred, little help can be expected, in fact, they are mainly responsible for the very low salaries which are now usual.

What might help, would be a big system of examination and registration, to include all from the lowest to the highest.

The efficient man (be he a wireman, or chief engineer) might then get a chance of competing with the "inefficient," who has a deep pocket or influence to help him.

B.

Neepsend Power Station.

Our attention has been drawn to an article appearing in your issue of July 15th, descriptive of the Neepsend Power Station at Sheffield. In the part of the article referring to the Ellis & Eaves induced draught installation on Stirling boilers, you say that the air heating apparatus is a patent of Mr. Fedden, the chief engineer. This is an error, as the Ellis & Eaves induced draught installation comprises air heaters, fans, air ducts on sides and front of boilers, chimneys, &c. We may say that the application of Mr. Fedden's patent in this case simply consists of connecting our hot air duct along front of boiler by supplementary ducts to Bennis's hollow bars, and has nothing whatever to do with the heating of the air.

We shall be glad if you will kindly make a correction of this in your next issue.

John Brown & Co., Ltd.,
CHARLES F. DOLBY.

Sheffield,
August 5th, 1904.

Localisation of Earths.

My remarks on Mr. Boot's system of fault finding have, I think, elicited statements which add to the value of his communication. He did not say that the table of results gave consecutive records, and by describing it as *some* results, left it open to the assumption that they might be selected. I take it also from his reply that they were all determined by the minimum process of experiment. It is also useful to know that a density of 100 amp. per square inch may be relied upon for accurate results. Mr. Boot, however, still abstains from estimating the cost or the time, which is, as he says, of great importance.

Curiously enough it is just the question of time which helps to keep the "barbaric" method alive.

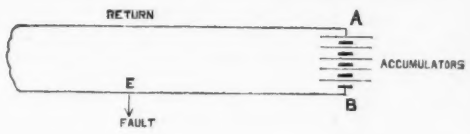
When a fault on a network is causing an interruption of the supply, the first thought of most station engineers is how to reinstate a large portion with the least possible delay. Cut it in half and make the good portion alive, is obviously the first thing to be done, and by continuing this, making temporary joints on live wires, it is sometimes possible to get every consumer on in a very short time. There have been many cases within my experience where I have considered such a process to be amply justified, and it can be carried out without specially skilled assistance. On the other hand there are cases which call for more scientific methods, and practical results such as those given by Mr. Boot, together with an accurate description of the most suitable apparatus, are of very great value, and may possibly prove to be a deathblow to "barbarism."

J. Rutherford Blaikie.

Southwark,
August 12th, 1904.

Mr. Boot will find, on referring to your issue of August 5th, that nobody suggested using any other return than the inner of a concentric cable, for the purpose of localising an earth on the outer, but if he has discovered a method of localising a short on a concentric cable by testing from one end only, without the use of an independent return cable, I, no doubt in common with many other engineers, would be glad of a diagrammatic sketch.

Also, no doubt, it would be a waste of time to make a check test if jointers and mains maps were perfect, but, anyway it is cheaper than breaking up even a few yards of road (quite £1 per yard in London) and cable, as he must have done in many instances. As to tabulated results, I have no records by me of the many tests on the length of cable in question, and if I had, possibly very few would believe them, but I think there were five separate faults, and the three that were accessible, *i.e.*, not in pipes, were repaired without jointing in extra cable. I may say here that a friend of mine in London has had the greatest possible success in localising earths on 1 sq. in. section, single lead-covered distributors, by the following simple method :—

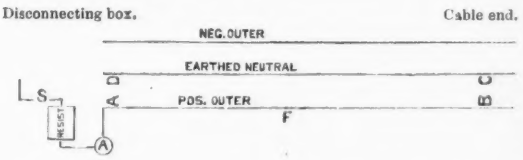


Send largest available current round loop and take pressure of A to earth, and B to earth with millivoltmeter, then, of course, pressure falls A to E and B to E are proportional to lengths.

A. J. Howard.

Leicester, *August 15th*, 1904.

With regard to the interesting discussion on localising faults, it seems that not only on mains does fault finding take place. Personally, not having had the lengthy experience of some of your contributors, I am not in a position to criticise. It appears to me, however, that as the cost of most testing apparatus prohibits its general use, a simple plan would be acceptable. I therefore submit the following, which I believe will be found of use:—Supposing we have a three-core cable, say ·06, ·03, ·06, on the positive of which there is an earth F, the system being three-wire low-tension, with earthed neutral.



Insert between positive end of cable and box, switches, resistance and ammeter A ; a fuse, not shown, would be useful. Send current through cable of, say, 30 amperes, which will go to earth at F. Then take volts at A D, next take volts at B C, which will give reading minus drop from A to F, then $R = \frac{V^0}{C}$, from which can be calculated length from A to F. The result, I believe, will be fairly accurate, and the outlay nil, as the apparatus is that in daily use at every works.

A. T. Hammett.

Dartmouth, *August 16th*, 1904.

[MUNICIPAL APPOINTMENTS.—"Applicant" applied for a municipal appointment as electrical engineer, but failed. The Clerk to the Council sent him a printed notice notifying that he was unsuccessful, and this notice was forwarded in an *open* envelope by half-penny post. Our correspondent points out, as others have done before him, the great inconvenience and unpleasantness likely to be caused to applicants by such procedure, and he also requests us to comment upon this example of municipal meanness. Really, on the face of it, the practice is so reprehensible that there is only one attitude to take up in regard to it. We can only think that thoughtlessness or inadvertence on the part of some overwrought official or posting clerk is the real cause, and a protest in the proper quarter might prevent a recurrence.—EDS. E.R.]

THE PRESIDENTIAL ADDRESS AT THE BRITISH ASSOCIATION.

The subject of the Prime Minister's eloquent presidential address to the British Association was "Reflections Suggested by the New Theory of Matter." By the new theory of matter was meant the electron or corpuscular theory, whose development is almost entirely due to the Cambridge school of physicists. Considering that Mr. Balfour's mental activities are so largely absorbed in an entirely different field, his accurate and lucid exposition of this somewhat abstruse subject speaks well for his knowledge of and interest in physical science; and we may congratulate ourselves on having at the head of affairs a statesman who is not, through ignorance of science, likely to fail in his appreciation of the supreme value of science and its applications in the modern state.

Mr. Balfour's exposition of the electron theory of matter was, however, only a preliminary basis for the main object of his address, which was a criticism and attack on the inductive theory of J. S. Mill and his school. He objects to the view of that school, that science is founded on experience. The latest views of science on matter, namely, the electric theory of matter, "diverge violently from those suggested by ordinary observation," which alone, in Mr. Balfour's opinion, is entitled to be called "experience." "No scientific education is likely to make us, in our unreflective moments, regard the solid earth on which we stand, or the organised bodies with which our terrestrial fate is so intimately bound up, as consisting wholly of electric monads very sparsely scattered through the spaces which these fragments of matter are, by a violent metaphor, described as 'occupying.'"

Nobody will fail to perceive the ever widening gulf which separates what the plain man perceives in Nature, from the theories which the scientific man evolves by an elaborate system of reasoning founded on observed phenomena. These theories, or conclusions of science, Mr. Balfour maintains are not "experience," but, we thank heaven, that Mr. Balfour does not expect the scientific man to settle this knotty point. He says, "we here touch the fringe of a series of problems with which inductive logic ought to deal, but which that most unsatisfactory branch of philosophy has systematically ignored. This is no fault of men of science. They are occupied in the task of making discoveries, not in that of analysing the fundamental propositions which the very possibility of making discoveries implies." It is to be hoped that a greater than John Stuart Mill will soon arise, who will evolve a satisfactory philosophy and logic of science.

Mr. Balfour is, however, inclined to the view that Nature may never produce a man who will create a satisfactory philosophy of science, or a man who would understand it if it were created, because "natural selection only works through utility. It encourages aptitudes useful to their possessor or his species in the struggle for existence, and for a similar reason it is apt to discourage useless aptitudes, however interesting they may be from other points of view, because, being useless, they are probably burdensome."

This appears to mean that as there was no particular use for a Philosophy of Science, Nature refused to evolve the mind that could understand it. This idea is further developed in a fine passage, giving in a few brief sentences a vivid picture of the evolution of the universe as understood by modern science:—"Considerations like these, unless I have compressed them beyond the limits of intelligibility, do undoubtedly suggest a certain inevitable incoherence in any general scheme of thought which is built out of material provided by natural science alone. Extend the boundaries of knowledge as you may; draw how you will the picture of the universe; reduce its infinite variety to the modes of a single space filling either; retrace its history to the birth of existing atoms; show how under the pressure of gravitation they became concentrated into nebulæ, into suns, and all the host of heaven; how, at least in one small planet, they combined to form organic compounds; how organic compounds became living things; how living things developing along many different lines, gave birth at last to one superior race; how from this race arose, after many ages, a learned handful who looked round on the world which thus blindly brought them into being, and judged it, and knew it for what it was. Perform, I say, all this, and, though you may indeed have attained to science, in nowise will you have attained to a self-sufficing system of beliefs. One thing at least will remain, of which this long drawn sequence of causes and effects gives no satisfying explanation; and that is knowledge itself."

This eloquent passage puts Mr. Balfour's view in a nutshell, and explains the multiplicity and contradictions of metaphysical systems by the simple theory that we are, in these subjects, dealing with ideas which are beyond the resolving power of the human mind. We are inclined to agree.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending August 18th, 1903.		Week ending August 16th, 1901.	
Alexandria	Value £43	Adelaide	Value £200
Antwerp. Elec. fuse	336	Alexandria	42
Auckland	14	Amsterdam	63
Bombay	20	Auckland	22
Brisbane	46	Bangkok	507
Buenos Ayres. Teleph. cable..	250	Beira	67
Calcutta	2,150	Bombay	52
Cape Town	1,042	Brisbane	28
Colombo	22	,, Teleg. mat.	367
Durban	138	Buenos Ayres	154
East London	873	,, Teleg. cable ..	400
Gibraltar	697	Calcutta	160
Hong Kong. Teleg. mat. ..	43	,, Elec. machinery ..	759
Kobe. Elec. instruments ..	923	,, Teleg. mat.	100
Moji. Submarine cable.. ..	284	Callao. Submarine cable ..	3,680
Montreal	40	Coatzacoalcos	20
Nagasaki	369	Cape Town	51
Rangoon	20	,, Elec. machinery..	33
Rio Janeiro. Teleg. apparatus	2,466	Christiania	14
Rockhampton	36	Canton	292
Shanghai	556	Colombo	62
Singapore	92	Durban	691
Stockholm. Teleg. wire ..	129	East London	382
Sydney	60	,, Elec. machinery	501
,, Teleg. mat.	650	,, Teleg. mat. ..	197
Wellington	85	Flushing	25
		Fremantle	40
		Genoa	259
		Ghent	48
		Gibraltar	5
		Hamburg	54
		Hong Kong	45
		,, Elec. machinery ..	782
		Larache	30
		Lisbon	15
		,, Elec. instruments ..	101
		Lyttelton	47
		Malta. Teleg. instruments ..	65
		Melbourne	200
		Port Elizabeth	133
		Rio Janeiro	200
		Rockhampton	151
		Rotterdam	40
		St. Petersburg. Elec. machinery	205
		,, Teleg. cable ..	170
		St. Vincent. Teleg. mat. ..	26
		Shanghai	191
		Sydney	87
		,, Teleph. cable	216
		Wellington	128
		Yokohama	294
		,, Elec. machinery ..	3,604
Total ..	£11,393	Total ..	£15,938

Foreign Goods Transhipped.

Antwerp. Elec. mat. ..	Value £120
Bombay. Elec. mat.	90
Cape Town. Elec. mat. ..	14
Durban Elec. goods	50
Launceston. Elec. lamps ..	20
New York. Elec. machinery ..	1,062
Wellington. Elec. mat... ..	40
Total ..	£1,396

Dissolutions and Liquidations.—August 26th is the last day for receipt of proofs for the intended dividend of the Warrington and District Electric Light and Power Co. Liquidators: Messrs. E. Bradshaw and E. E. Johnson, the former of 4, Egypt Street, Warrington, and the latter of 78, King Street, Manchester.

A meeting of the British Electromobile Co., Ltd., is to be held at 25, Abchurch Lane, E.C., on September 21st, to hear an account of the winding-up from the liquidator (Mr. P. D. Leake).

Simplex Conduits.—The Simplex Steel Conduit Co., Ltd., has submitted to us a sample of its new contact nipple, whereby it is claimed efficient and permanent continuity and earthing can be secured with ordinary unscrewed "Simplex" conduits. It is stated that by the introduction of this nipple, all types of these conduits can be erected electrically continuous and efficiently earthed. A special sheet has been issued by the company giving particulars of the nipples and the advantages which they possess. The list details the low first cost of material with the Simplex continuity system, and the saving which is effected in labour cost because the erection is exactly on the lines of ordinary socket joint conduit work. The system consists of a combination of ordinary unscrewed conduits used in conjunction with screwed fittings and contact nipples.

Double Fuse Plug for Stage Use. — We illustrate herewith (figs. 1 and 2) a new stage plug which has been specially designed and made for stage use. Each plug is made so that if there is any sudden jerk on the wire it will not pull the wire out of the terminals. The large size is used for heavy circuits, and will carry up to 40 amps.; a smaller size is used for light circuits, such as side lengths, &c., and will carry up to 10 amps. The sockets for

Fig. 1. Fig. 2.

the plugs are screwed underneath the stage board at the most convenient place; a hole is cut large enough to allow two small plugs to be freely inserted (fig. 3). The iron cover is recessed as shown, and will fit flush with the stage boards. This protects both plugs and sockets, and allows scenery to be run over it without fear of damage when plugs are inserted. The iron covers, being double hinged, fall back quite flat when opened for inserting the plugs. It

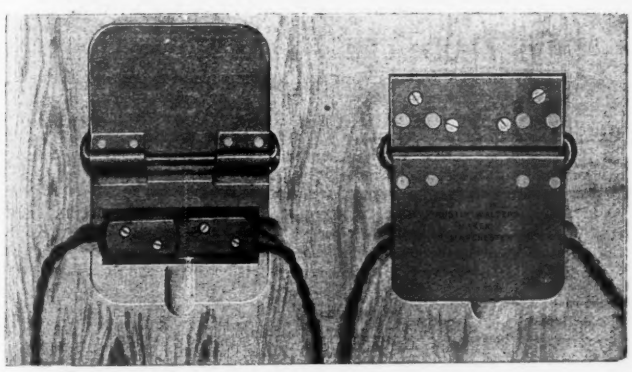
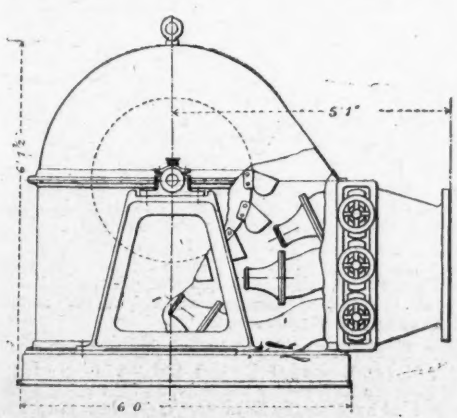


Fig. 3.

is claimed that by means of this arrangement a connection may be fixed almost anywhere under the boards of the stage without interfering with the sliders being drawn off, thus saving cutting of stage joists. It allows more than one plug to be inserted in the same connection at the same time, and does not project more than 1 in. below the boards of the stage; nails, screws, or water may pass through it without damage. The plug carries its own fuses, thus protecting its own circuit.

Pelton Water-Wheels.—Mr. Percy Pitman, of Bosbury, Ledbury, recently constructed for use in some Rio gold mines, a 50-B.H.P. Pelton water-wheel of the multiple nozzle type. The wheel is 4 ft. in diameter, of ½ in. steel plate, and is mounted on a 3 in. shaft; it runs at 135 revs. per min. when dealing with 700 cubic



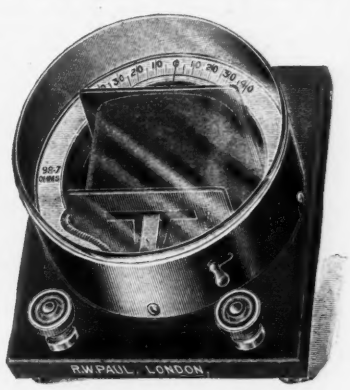
50-B.H.P. Pelton Wheel.

feet of water per minute at 50 ft. head. The water passes to three nozzles, as shown in the accompanying diagram, through three valves which are controlled by the hand-wheels which are seen outside. Each nozzle is of 3⅝ in. diameter, and is constructed of phosphor bronze. The buckets, bearings, valves and seatings are also of the same metal in order to prevent corrosion. Access to the buckets and nozzles is easily obtained by the removal of the top half of the casing. Mr. Pitman asks us to notify that he has permanently removed from Halifax, Yorks., where his business was carried on for many years, to the Bosbury works. He is making a speciality of high pressure wheels to work off the hydraulic power mains, and also of low pressure motors for the ordinary towns' pressure water. He has supplied many of his standard Pelton wheels with extended sole-plates to take dynamos, alternators, exciters, &c.

Germany.—The exports of electrical machinery from Germany during the five months ending with May last amounted to 5,640 tons, as compared with 5,158 tons in the corresponding period of last year. There has also been an increase in the imports of foreign electrical machinery into Germany, from 322 tons in the first five months of 1903, to 500 tons in the five months ending with May last.

Engineering Apprenticeships.—Mr. W. H. Allen, of the Queen's Engineering Works, Bedford, has offered to apprentice two boys yearly to mechanical and electrical engineering at the works, and the County Council has accepted the offer in connection with the Technical Education Scholarships.

A Handy Portable Galvanometer. — A simplified form of the standard P.O. Galvanometer has been devised by Mr. Robert W. Paul, of 68, High Holborn, W.C., which is well adapted for use in localising faults, bridge and insulation tests, &c. The accompanying figure shows the general appearance of the instrument; the working parts, which are supported on a removable



Sensitive Galvanometer.

slider fitted to the rigid brass bobbin, are of standard type, while the case has been reduced to a simple form. The magnetic needle is fitted with a jewelled cap and a balanced aluminium pointer, and rubber pads are provided under the base; no levelling is necessary. The coil is wound to 100 ω, giving a deflection of 1 degree with ·000,008 ampere, or 1,000 ω, giving the same deflection with ·000,002 ampere.

Receiver Appointed.—Mr. E. R. Spackman has been appointed receiver of Ross, Courtney & Co., Ltd., screw manufacturers, Upper Holloway, on behalf of the debenture holders. The debentures are for the total sum of £5,800. The business will at present be carried on by Mr. Spackman, and he will be responsible for all orders placed after August 11th.

Book Notices.—"The Telephone Service: Its Past, Its Present, and Its Future," by Herbert Laws Webb, M.I.E.E. 1s. London: Whittaker & Co.

Journal of the Institution of Electrical Engineers. Vol. XXXIII., Part 4, July. London: E. & F. N. Spon. 5s.

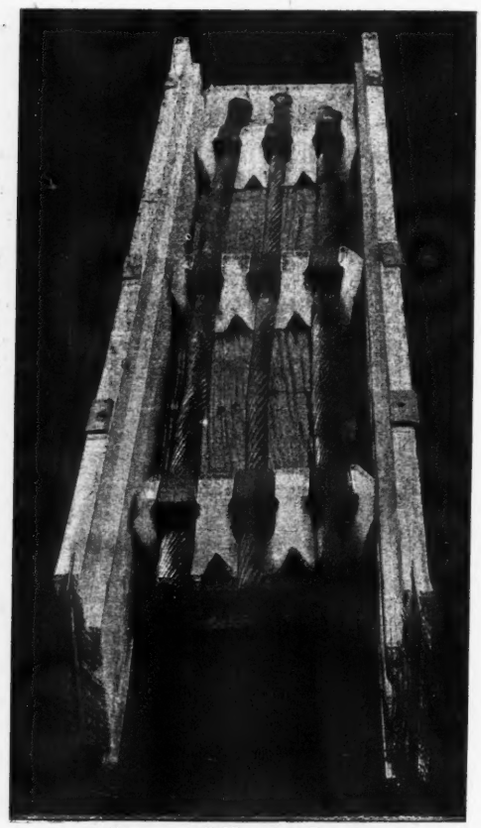
"Report of the Tariff Commission. Index to Vol. I. The Iron and Steel Trades." London: P. S. King & Son.

"Calendar of the Glasgow and West of Scotland Technical College, for the Session 1904-5." Glasgow: The Secretary, at the College.

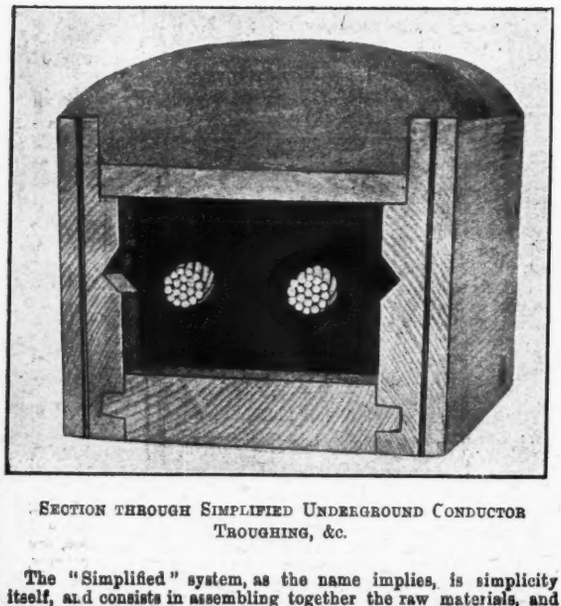
The Technology Review. Vol. VI., No. 3, July, 1904. Boston, U.S.A.: The Association of Class Secretaries. Price, 35 cents.

The F. E. Coe "Red Book" on Advertising. F. E. Coe Agency, High Holborn, W.C.—The success of advertising is dependent upon many things, and this fact has been recognised by most large establishments connected with the electrical engineering trades during the past few years, and to that end many of them have established "Publicity" departments, whose particular duties, we suppose, are to see that their advertisements are put in the right publications, and drawn up in attractive form and frequently altered, and that the preparation and circulation of price lists and catalogues are thoroughly seen to. In the book now before us there is some information regarding publications which would be more valuable if it were more complete respecting circulations, and advertisement prices are given which may or may not be correct. In the general matter of the book it is possible that there may be found some tips which will enable the publicity department man to render himself more "fit" for his duties, though its chief design is to induce the man who has never advertised to experiment in that direction.

A Simplified Mains System.—Amongst the many problems confronting electrical engineers and awaiting solution, none are of greater importance than those relating to the efficient distribution of electrical energy. A large proportion of the heavy initial cost of insulated cables is entailed by the operations to which the metallic conductor is subjected at the cable factory, and any invention which has for its object the elimination of the factory insulation, and the provision of a cheap and efficient system of underground mains, should appeal strongly to electrical engineers and to local authorities responsible for the spending of public money. The "Simplified" solid system was brought out for this purpose about two years ago.



"Simplified" Mains in Position.



Section through Simplified Underground Conductor Troughing, &c.

The "Simplified" system, as the name implies, is simplicity itself, and consists in assembling together the raw materials, and constructing the main *in situ*. The troughs, which may be of any suitable material, are laid in the trench; porcelain bearers or bridges are spaced at short intervals therein, and bare stranded conductors are placed on and securely wedged into these bridges. Carbolite, the inventors' special insulating compound, is then run into the trough so as to entirely cover the conductors; an inner lid of wood is placed in position, and the whole is finished off with a continuous cover of carbolitic asphalte.

It will be observed that the above system depends for its efficiency on a minimum of details, and it may be of interest to describe rather more fully the various component parts. The troughs are usually of sound red pitch-pine, machined to certain standard shapes and sizes, and rapidly put together by metal bands, which are sprung on. Special attention has been devoted to the provision of an efficient method of jointing individual lengths of troughing together. Where two planks (whether forming sides or bottoms) butt against one another, each is provided with a saw cut, into which a small tongue of metal is inserted; by this means an absolutely tight joint is obtained between the butting ends of the troughing. The insulating bridges are of porcelain, possessing a highly vitrified body which is unglazed and absolutely non-hygroscopic. The edges of the bridges engage with grooves machined in the sides of the troughing, by which means the bridges are kept securely in position.

The bridges being fixed in position, the conductors are paid out and laid upon them and securely wedged down into them. Expansion and subsequent contraction have been, in the past, amongst the most fruitful sources of trouble during the construction of solid system mains, and it was with a view of obviating this, and of transmitting its effects in such a direction as should not affect the efficiency of the main, that the inventors adopted the wedging process.

Little need be said about the bare metal conductors, but it may be noted that the invention lends itself admirably to the use of metals other than copper. The relative conductivity of aluminium and copper for instance, and the increased sectional area of the former metal for given current capacity, make little or no difference to the standard sizes of troughing, the size of the trough to contain copper conductors being, in most cases, the same in the case of aluminium. For small mains too, it is quite possible to use iron for the conductor. Whatever metal is adopted, the inventors invariably advise the use of soft-drawn wire, and in stranded conductors the lay to be kept as short as possible.

The insulating compound is composed of refined carbolite, a material with highly insulating properties, which is absolutely waterproof and non-hygroscopic, and which at the temperature of the surrounding soil sets to a very tough and slightly plastic consistency. It has also an extraordinary power of resistance to breaking down under high pressures, a length of low-pressure main having recently been subjected to an alternating difference of potential between conductors of 20,300 volts for 10 minutes, without showing any signs of breaking down.

As an illustration of the extremely flexible nature of the simplified system, as a whole, it may be of interest to mention that whilst carrying out an extension some little time ago, it was found necessary, owing to the re-levelling of one of the roads, to lower the main some 18 in. below the level at which it had been originally laid. Some 200 yds. of three-wire distributor were successfully lowered in this way, and that whilst the main was alive, and without removing any of the filling, or in any other way disturbing the completed main.

The primary object of the inner lids is to provide a support for the asphaltic cover. They are generally composed of wood, and are put on in short lengths of about 3 to 4 ft. each, being easily removed for purposes of service connections, and so forth.

The outside cover is composed of carbolitic asphalte, which is made and supplied by the Simplified Co. in compact ½-cwt. blocks, ready for use. The blocks are readily melted in a boiler, and the molten asphalte is then poured on to the main from end to end; it is tooled off with a hot iron, and quickly sets hard and tough. Amongst the many advantages claimed for the Simplified system, we may mention the fact that it is quite practicable to considerably overload the conductor. This distinctive feature of the "Simplified" main is of especial value in connection with feeders for electric tramways, and, indeed, a tramway feeder laid on this system by the Simplified Underground Conductor Co. in the Spring of 1903, has been working under an overload of nearly 50 per cent. without giving the smallest trouble since it was put down.

Contracts for mains laid on this system have been carried out during the last three years for the Corporations of Blackpool, Salford, Bootle, St. Anne's, &c., and at Ledsham, Blundellsands, Witley, Eastham, Knowsley, and other places.

Several Corporations are now installing the Simplified system, utilising their own labour and working under licence from the Simplified Co., and this plan will, no doubt, commend itself to many engineers who make a practice of laying their own mains. The Simplified Underground Conductor Co., Ltd., has its head offices at 35, Castle Street, Liverpool.

A Hint from Rio de Janeiro.—A correspondent writes from Rio de Janeiro, Brazil, under date July 21st, as follows:—"I think it would be well if electric lighting firms gave their attention to Rio Janeiro during the next few years. The city is undergoing radical alteration and reconstruction, and there is, at present, no general scheme of electric lighting, although the matter is, I understand, under consideration by the S. Paulo Light and Power Co. (whose head office is at Toronto, Canada) in connection with an extensive traction scheme."

Sawing Machines.—The Admiralty has recently placed orders with Messrs. Edward G. Herbert, Ltd., of Manchester, for a number of their eccentric sawing machines, who have, at the present time, machines in hand for the Royal dockyards at Chatham, Devonport, Sheerness, Portsmouth, Pembroke, Haulbowline, Gibraltar and Malta.

Stalybridge.—The Victor Mill, Ltd., has accepted the tender of Messrs. W. C. Booth & Co., of Stalybridge, for the electric light installation.

The "Minne" Lock Nut.—Messrs. D. Santoni & Co., Ltd., of 28, Ely Place, Holborn Circus, E C., are introducing the above patented lock nut, of which they are the sole manufacturers. It is claimed that the Minne lock nut offers the most simple solution of efficiently locking a nut. Knowing that the locking quality of a nut is based upon the wedging of its first lower screw thread, and that the wedging action is to a great extent minimised in ordinary practice by the large surfaces in contact, the inventors have introduced a lock nut of very small dimensions and having a minimum

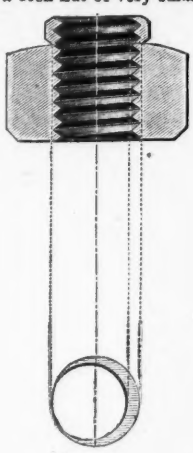


Fig. 1.

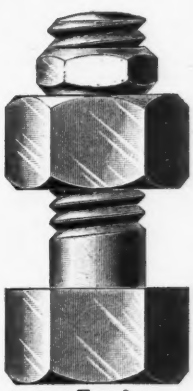


Fig. 2.

of contact surface (shown by the shaded portion, fig. 1). This, it is claimed, allows of a maximum wedging effect on tightening up. Further, the risk of unscrewing under vibration is reduced to a minimum, as the heavier nut would, owing to its greater active energy, unscrew more rapidly than the small lock nut, and consequently wedge itself more tightly. The correctness of these theories has been confirmed by both the German and American Patent Offices, and by actual trials on railway and tramway track, locomotives, motor cars, and machinery.

Bankruptcy Proceedings.—The first meeting of creditors was held on Thursday, at the London Bankruptcy Court, before Mr. C. A. Pope, Assistant Receiver, under the failure of Warner & Co., builders and electricians, late of 12, Holbein Place, Sloane Square, S.W., present address unknown. The receiving order was made on the petition of Messrs. T. & W. Ide, Wells Street, Oxford Street, the act of bankruptcy cited being notice by the debtors in April and May of suspension of payment. The Chairman reported that the debtors had not surrendered under the proceedings, and that nothing was known of their whereabouts. An inspector of the Court had attended at 12, Holbein Place, and was informed that the debtors left the premises in the early part of June, taking with them the stock of electric fittings, and the books and papers. A creditor said he believed the firm consisted of George William Warner and Arthur Bowen, and a resolution was passed for those persons to be adjudged bankrupt, and Mr. A. C. Bourner, chartered accountant, Bush Lane, Cannon Street, E.C., to be appointed trustee, with the following committee of inspection, viz., Mr. H. Clark (T. & W. Ide), Mr. H. Grant (Veritys, Ltd.) and Mr. F. H. Rosher. The public examination of the debtors has been fixed for September 20th.

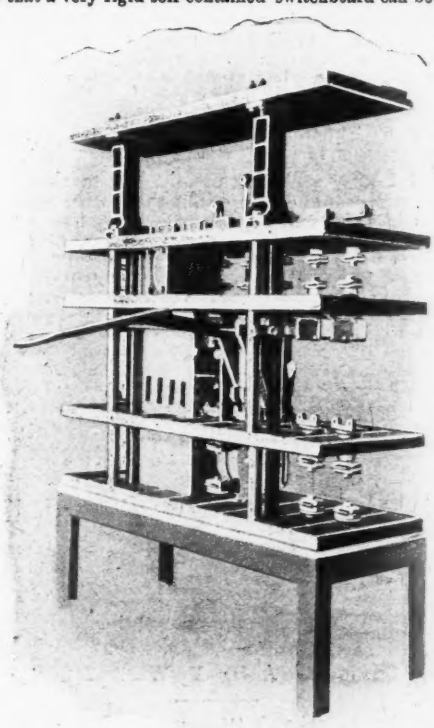
At a sitting of the London Bankruptcy Court, held on the 12th inst., before Mr. Registrar Giffard, the case of Mr. Max Margowski (Automatic Telephone Co., Ltd.) was mentioned in connection with the debtor's application for an order of discharge. Mr. Hewitt, on behalf of Mr. F. S. Salaman, the trustee, applied for an adjournment on the ground that his client was making further investigations, with a view to the recovery of assets, it being alleged that the debtor had transferred property to his wife through the medium of a dummy. Mr. Denman, for the debtor, consenting, the case was ordered to stand over until October 28th next.

At Liverpool Bankruptcy Court, on August 10th, John James De Lacy and Howard Ryan De Lacy, trading as De Lacy Bros., electrical engineers, of Liverpool, were again examined. John De Lacy was questioned as to an engagement with a Mr. Arthur Brown, who was manager for a year, and from whom various sums of money were borrowed and put into the business. Debtor stated that the money was borrowed at a time when they believed themselves to be thoroughly solvent, and it was intended that Mr. Brown should ultimately have a substantial interest in the business. The examination was closed.

Snowdon's Flame-Preventing Fluid.—Mr. F. Seaton Snowdon, consulting engineer, of West Dulwich, S.E., has introduced a flame-preventing chemical combination with which, at slight cost, it is possible to flame-proof textile fabrics of the most delicate description, matting, paper, wood, &c, and any ordinarily inflammable substance. This fluid has already received recognition from theatre authorities, and many trial orders are in process of execution. These "flame preventers" are sold in the form of powder, starch or liquid, and are manufactured by Snowdon's Flame Preventers Co., 10, Tudor Street, London, E.C.

Condensing Plant.—It is well known that Messrs. The Mirrlees, Watson Co., Ltd., of Glasgow, have made a speciality of condensing machinery, and the following list of orders received during 1904, will serve to convince steam users that the firm's products are meeting with due recognition:—Leeds Corporation (lighting), surface condensing plant of 32,000 lbs. steam per hour capacity; Northampton Corporation, ditto, 12,000 lbs.; Bradford Corporation (repeat) (per J. Musgrave & Sons), ditto, 21,400 lbs.; Egyptian Government, ditto, 15,000 lbs.; Redpath, Brown & Co., ditto, 12,000 lbs.; J. Musgrave & Sons (for South Africa), ditto, 13,500 lbs.; Burgh of Greenock, ditto, 25,000 lbs.; Whitby U.D C., ditto, 7,500 lbs.; Partick E.L. works, ditto, 18,000 lbs.; G. H. Powden, Manchester, ditto, 8,000 lbs.; Premier (Transvaal) Mining Co. (per Fullerton, Hodgart & Barclay), ditto, 22,500 lbs.; Inveresk Paper Mills (per British Westinghouse Co.), ditto, 15,000 lbs.; Folkestone E.L. works (per Edmundson's Electricity Corporation), ditto, 15,000 lbs.; Cardiff Electricity Works, ditto, 30 000 lbs.; Willesden U.D.C., ditto, 15,000 lbs; Madeira Electric Light Co., ditto, 16,000 lbs.; Bristol Corporation (per Willans & Robinson), ditto, 17,000 lbs.; Kilmarnock E L. works (per Aiton & Co.), jet condensing plant of 18,000 lbs.; Clyde Valley Electric Power Co. (per British Westinghouse Co.), ditto, 80,000 lbs.

A form of re-construction for Cellular Switch-Gears.—A good deal has recently been written and said concerning the safety of high-pressure switchgear, but considering the importance of the subject one cannot say that too much attention has been given to it. Messrs. Walker & Hodgetts, Ltd., of Salford, have set themselves the practical task of demonstrating improvements in the construction of existing H.T. switchgears of the type which has in the past been universally appreciated for use in central stations, particularly upon single-phase systems of 2,000 to 3,000 volts. The improvements consist of some simple detail alterations to the fuses, with several objects in view, among which may be mentioned the avoidance of the use of springs, the provision of a new type of flexible conductor inside the pots, and also a mechanical method of fixing the fuse wire in order to replace the existing soldered connections. In the modification of the general construction of the gear, the heavy horizontal slates are taken out of the wall, and the switchgear is re-constructed in the reverse position, so that what has been the back now becomes the front, and *vice versa*. This is illustrated in the accompanying view, taken from a trial board. It will be noted that there are four sets of bolts and distance pieces holding the slates together, and it is found that a very rigid self-contained switchboard can be obtained



Reconstructed Cellular Switchgear.

in this way, although in actual practice, on a board of the size illustrated, six or eight bolts are used; the bolts are cemented into the distance pieces, and so the construction becomes as solid as if it were mounted on the wall. It will be seen at once that by this means the switches and fuses are removed from the operator. He is shielded from any possible arcing from these by two thicknesses of slate slabs. At first sight it is suggested that this method introduces a back, which has hitherto been absent from the type of gear in question, but on after-thought and inspection it will be found that the objection to a back is practically removed, in that it is possible to see, from the station, any person at the back through certain portions of the gear; moreover, the fittings at the back are now shielded in identically the same way as those visible at the front in the original design.

The illustration shows cellular switchgear for 2,000 volts, which was reconstructed as a test with only four cramping bolts. In order to show clearly the construction and proposed method of operating the switch, the front slate covering the switch and fuse panels, all division slates, and all but two of the ½-inch back slates are removed.

Catalogues and Lists.—Messrs. John Davis & Son (Derby), Ltd., have issued a capital and timely pamphlet (60 pp.) bound in stiff red covers, showing many illustrations of the Jeffrey coal-cutters. The various manufactures of the Jeffrey Manufacturing Co., for whom Messrs. Davis are the sole representatives in Great Britain, are described. The list is in two sections, one dealing with electric coal-cutters, and the other with those driven by compressed air, some designs of electric locomotives for mining work bringing up the rear.

Messrs. James Gibb & Co., of Fenchurch Street, E.C., have issued a circular describing their improved patent ventilating cover and frame for electric lighting and other purposes. The principal feature of the cover is the bevel which extends round its underside and through which the ventilating slots are cast. Any moisture which passes through the slots will therefore fall to the lowest part of this bevel, and will then drop into the channel in the frame, whence it escapes through the outlets in the corners of channel into the surrounding earth. The channel is so made that water cannot trickle, or be blown, into the pit. It slopes from the centre towards the outlets, thereby preventing any lodgment of water or dirt, and keeping the channel perfectly clean and free. The slots provided in the cover ensure the efficient ventilation of the pit, and as the cover has no bead or projection underneath this, ventilation is claimed to be free and unimpeded.

The Crypto Electrical Co., of Bermondsey, are sending out new circulars relating to their alternating current motors, motor-generators, and cut-outs.

Messrs. L. Andrew & Co., of Manchester, have issued a net wholesale price list of insulating materials for electrical purposes.

Messrs. Alfred Graham & Co., of St. Andrew's Works, Peckham Park Road, S.E., and other addresses in London, have just issued an illustrated catalogue, showing the various types of telephones made by them for ship use. These instruments, we understand, are employed in H.M. Navy and on the "liners" of the mercantile marine. The list consists of good art paper, with many photo-process illustrations showing the instruments in use, and the apparatus detailed includes navy 'phones, shutter 'phones, pillar 'phones, and cabin and works loud speaker type telephones.

Schmidt and Easton Patent Superheaters.—Messrs. Easton & Anderson, engineers and successors to the general engineering business recently carried on by Easton & Co., Ltd., announce that they have taken over the superheating business lately carried on by the latter concern. They will have the advantage of all the patterns and drawings, as well as the old expert staff, and will therefore be in a position to supply the Schmidt and Easton superheaters as heretofore. In the future the manufacturing will be carried out by Messrs. J. and E. Wood, of Victoria Foundry, Bolton, under supervision.

Nernst Lamps.—We have received from the Electrical Co., Ltd., a pamphlet containing illustrated descriptions of the recent developments in Nernst lamps, together with some interesting records of their efficiency. The company is distributing the above to its numerous customers, and has now made arrangements for fully protecting its patrons against infringement actions, &c. An arrangement has also been come to between the patent holders and licensees, whereby special discounts have been fixed, and came into force on the 1st inst., to which the vendors of these lamps are bound to adhere in the future.

Americans in Oriental Markets. — U.S.A. Consuls in the Far East are warning American shipping firms of the undesirability of trying to unload unsaleable and out-of-date goods, including electrical appliances, on Oriental purchasers, for the Oriental mind is very easily prejudiced against a whole class of goods.

Trade Announcement. — The Bradford Electrical Engineering Co., of Volt Works, Trafalgar Street, Bradford, have acquired premises at 3, Royal Arcade, Manningham Lane, where they will have a fully-equipped show-room of electric light fittings and heating apparatus.

LIGHTING AND POWER NOTES.

Birkenhead.—The T.C. has approved the resolution of its Electricity Committee to accept the tender of Messrs. Johnson & Phillips for the supply of materials and the execution of works for the supply of electricity to Prenton and Upton, and that, subject to a prov. order being obtained, application be made to the L.G.B. for sanction to borrow £6,500 to carry out these extensions.

Bristol.—The Bristol Gas Co. proposes to light the basement of its new offices, which are about to be erected, by electricity. A complete gas-driven installation for the generation of energy for light and power will, it is stated, be laid down.

Boston.—The T.C. has been recommended by its Paving and Lighting Committee to adopt an E.L. scheme, estimated to cost £17,263.

Cannock.—A L.G.B. inquiry was held last week into the application of the U.D.C. for sanction to borrow the sum of £10,000 for the purpose of supplying electricity to the district for light and power. The town clerk stated that it was proposed to borrow the sum for a period of 25 years. Messrs. Whittaker Bros., of Dudley, in 1902 made application to the Council to work its E.L. order, and to this the Council assented, but the B. of T. refused a transfer. The same firm has since submitted another proposal, and the Council intended, unless the L.G.B. offered objection, to work the undertaking under an agreement with Messrs. Whittaker Bros., which provides for a lease for 25 years, but determinable at the end of 14 years. The firm undertakes to repay the whole of the capital expended by the Council within the period for which the money is borrowed, with interest, and as a guarantee, to put £2,500 into the works. A number of representatives of edge tool works at Bridgtown and Wedge's Mills supported the application. Three local colliery companies, several ratepayers, and the Cannock, Hednesford and District Gas Co. opposed the scheme. The inquiry was adjourned for evidence for the opposition.

The B. of T. has informed the Staffordshire C.C. that it has decided not to grant the Cannock and District E.L. prov. order.

Conway.—The T.C. has decided to apply for a prov. order for electric lighting in the borough.

Dorking.—The formal opening of the generating station constructed by Messrs. Edmundson's Electricity Corporation for the supply of electricity to the town, took place on the 9th inst., the ceremony being performed by the Duchess of Marlborough. Electricity has been supplied to the town since March last, when 70 consumers, representing 1,500 lamps, were connected, but it is only recently that the works have been completed. The number of consumers now connected amounts to 120, with 4,000 lamps. The prices charged for the supply of energy for lighting are 7d. and 4d. per unit, one hour maximum demand or 6d. per unit flat-rate, and by the slot meter system, including rental of same, fittings, &c., 7d. per unit. Messrs. Edmundsons acquired a lease of the Council's prov. order, under which the whole of the required capital was advanced to them, Messrs. Edmundsons paying back to the Council in half-yearly instalments a sum equal to the amount which the Council have to pay for interest and sinking fund charges, and the instalments on all sums it has expended in capital in connection with the order. The Council has the option of taking over the undertaking at 7, 10, or 14 years, or any subsequent year. At the end of 25 years, when the lease expires, the undertaking will revert to the town free of cost.

Dublin.—On the 8th inst. the Municipal Council refused a motion to suspend standing orders, brought forward to enable a report of the E.L. Committee to be "rushed" through. The object of the manœuvre appears to have been to get a resolution from the Council endorsing the request for a loan of £21,000 to the Committee for the purpose of extending the generating plant at the Pigeon House works. The matter had already been discussed, when an application for this loan came before the L.G.B. On that occasion the Inspector dismissed the application, because it had never been formally approved by the Corporation.

Dumbarton.—The Electric Supply Corporation, which has the provisional order for supplying electric power to the town, has asked the Dumbarton T.C. for a further delay of six or nine months before starting the work, to enable it to come to arrangements with the company which is to utilise Loch Sloy Falls for electric supply purposes. The matter has been remitted to the Bills and Electric Committee to get the company to implement its bargain.

Exeter.—The T.C. has reduced the price of energy for ordinary lighting to 5d. per unit, and for power to 2½d.

Glasgow.—Subject to a slight modification of the power rate conditions, the Committee has recommended to the Corporation that no alteration be made in the charges for energy during the year 1904-5. The quantity of electricity sold to private consumers during the past year was 13,604,119 units, as compared with 10,419,488 units during the previous year, being an increase of 30·56 per cent. The number of consumers at May 31st, 1904, was 9,324, as compared with 7,013 at May 31st, 1903, being an increase of 32·95 per cent. during the year. There were 268 consumers who consumed the equivalent of five hours or more per day of their maximum demand throughout the year, the consumption under this head amounting to 1,723,196 units in all. The total number of motors in use or supplied off the Corporation mains was 1,453, with a total horse-power of 6,501, as compared with 1,059, with a total horse-power of 4,597 last year. The number of units consumed for power purposes was 2,873,941. The total number of arc lamps erected and in regular use in the streets as at May 31st last was 814, as compared with 719 at the same date, 1903, and the quantity of electricity consumed for public lighting was 1,503,546 units, as compared with 1,081,836 units during the preceding year. The number of 8-c.p. lamps, or the equivalent, applied for was 805,058, as compared with 630,708, being an increase of 174,350. The maximum load amounted to 11,585 kw., as compared with 9,371 kw. last year, being an increase of 23·63 per cent.

Greenock.—From the accounts of the Electricity Department for the past year, a deficiency of £2,100 appears to have been incurred. This large adverse balance is accounted for chiefly by the Board of Trade decision in the arbitration case between the Corporation and the Tramway Co. Under that decision the department is compelled to supply energy at a figure much lower than it thought it was entitled to charge under the lease.

Halesowen.—The Empire E.L. and Power Co. has informed the U.D.C. that it will shortly commence to carry out its obligations under the agreement entered into for the provision of a supply of electricity, and the construction of electric tramways.

Hove.—The T.C. has approved of the action of the local E.L. Committee in requesting the Brighton T.C. to discontinue supplying energy to a house in the borough of Hove, although the meter is fixed in a corner of the garden, which is in the borough of Brighton.

The Hove E.L. Co. and the Hove and District Electrical Supply Co. have notified their intention of applying for prov. orders for electric lighting.

Huddersfield.—The Electricity Committee of the Corporation has passed a resolution requesting motor manufacturers to appoint agents in the city, and to enter into agreements, with a view to assisting the Committee in extending the use of motors.

India.—The *Pioneer Mail* states that the Committee appointed by the Punjab Government to investigate the question of water and electricity supply for Simla, has definitely rejected Major-Gen. Beresford-Lovett's scheme so far as it relates to the pumping of water from the Sutlej, which it was proposed to do by electricity, but has decided that electrical power shall be derived from Nauti Khud.

Ipswich.—On the recommendation of its engineers, the T.C. has decided to expend about £1,300 on additional boiler plant to meet the coming winter's load, and the sum of £460 on a smiths' shop and stores, in connection with its electric lighting and tramways undertaking.

Kingston (Ont.).—On August 1st, the municipal authorities took over the working of the Kingston Light, Heat and Power Co.'s plants. Flat-rate charges have been abolished. A local electrical expert has been engaged by the authorities to draw up a scheme for the improvement of the undertaking.

Kirkintilloch.—The Gas Committee, as a result of a canvass of the shopkeepers in the town, has suggested to the T.C. that a small installation be put down, partly as an experiment, to supply electricity to the district. The Council has agreed to interview an expert, to discuss the matter.

King's Norton.—The U.D.C. has decided to negotiate for the transfer of the E.L. order obtained in 1898 to a syndicate under a 21 or 25 years' lease. The district to be supplied with energy comprises Mosely, King's Heath, Moor Green, Selly Park, Bournbrook, Selly Oak, Ten Acres, Bournville, Stirchley, the Cotteridge, Middleton Hall Road, King's Norton, and Northfield; and the capital required (about £36,000) is to be found by the Council, by way of loan. The syndicate is to take steam from the refuse destructor at ¼d. per unit during dark hours, and ⅜d. during daylight, with a minimum payment of £500 a year.

London.—Islington.—On Wednesday evening a failure of the electric lighting service took place, lasting for half an hour, owing to the breakdown of an insulator at the generating station.

Louth.—The T.C. has sealed an agreement with Messrs. Handcock & Dykes in reference to the installation of the electric light.

Lytham.—The St. Anne's U.D.C. has notified the T.C. that it would be willing to discuss terms for the supply of electricity to the town.

Mansfield.—There was no opposition on August 10th at the L.G.B. inquiry into the application of the T.C. for a loan of £15,000 for E.L. purposes. Of this sum £10,986 represents excess expenditure over the original estimate, and £4,013 was for mains.

Mynyddislwyn.—The U.D.C. has engaged Messrs. Lewis & Fletcher, electrical engineers, of Cardiff, to advise it on electric lighting questions. It is proposed to take energy from the South Wales Electrical Power Distribution Co.

Newcastle (N.S.W.).—Mr. Raw, the electrical engineer to the works department of the City Council, has drawn up a report on the proposed extension of the E.L. plant, and recommends that the tender of Messrs. Noyes Bros. at £2,800, made up as follows:—Westinghouse engine, £487; Babcock & Wilcox boiler, £838; electrical machinery and apparatus, £1,475—be accepted; Messrs. Noyes Bros. to supervise the erection of the plant. Mr. Raw recommends that the present system of lighting should be changed over from 1,000 volts to 2,200, the cycles per second reduced from 133 to 50, and the system altered from single to three-phase.

Ormskirk.—The U.D.C. has approved the scheme proposed by the National Electric Construction Co. for the electric lighting of the township, and has authorised the Committee to draw up a form of agreement. The undertaking is to be run by the company on behalf of the Council, and should the profit of the first 10 years work out at over 3 per cent. per annum on the capital expenditure after providing for the sinking fund and interest, the excess will be refunded to the Council. The Council is to borrow the capital, and the company to construct the works. Public lighting charges, including maintenance and upkeep are to be 2⅝d. per unit, and private lighting, a flat rate of 5d., and on the maximum demand system 7d. per unit, and 3d. per unit after; power charges, 4d. and 1½d. per unit maximum demand for one hour in the first quarter. After seven years the Council can take over the concern upon payment of 10 per cent. on the capital expenditure, and upon the expiry of 10 years on payment of a premium of 7½ per cent. It is intended to make provision in the agreement that in the event of the estimate for the cost of the scheme exceeding £15,000, the Council will have the right to reconsider its position.

Penrith.—The U.D.C. has adopted the recommendation of the E.L. Sub-Committee that a scheme of electric lighting should be carried out, and that a loan of £6,850 be applied for, for that purpose.

Plymouth.—A loan of £20,000 for E.L. purposes has been applied for by the T.C.

Sheffield.—The T.C. has fixed the price of energy for motors, driving hoists, cranes, and passenger lifts, at 2d. per unit, and for other motors at 1½d. per unit.

Shipley.—The accounts of the E.L. undertaking of the U.D.C. for the year ended March 31st last in brief we give below, with a comparative statement of the financial results of the previous twelve months:—

	1904.	1903.
Revenue, private lighting and power	£4,339	£2,051
,, public lighting	468	282
Total revenue, including meter rents, sundries and discounts	£5,210	£2,723
Total works costs, including public lighting ..	3,137	1,909
Interest	1,533	722
Sinking fund	665	589
Debit balance charged to general district rate	£125	£447
Total works cost per unit, including public lighting	1·23d.	1·52d.
Inclusive average price obtained for all kinds of supply	2·05d.	2·16d.

The total number of units sold amounted to:—Private lighting and power, 190,113; public lighting, 56,000; traction, 362,411; total, 608,524. The number of lamps, motors, &c., equivalent to 8-c.p., connected, was 18,098, as against 8,147 in the preceding year. The maximum load recorded was 455 kw. As a result of the year's working, the number of units sold, both for private and traction purposes, has more than doubled those of 1902-3, and we anticipate that the result of the present financial year's working will be equally satisfactory. The electrical engineer is Mr. S. D. Schofield.

Soothill Nether.—The Yorkshire Electric Power Co. has offered terms to the U.D.C. for public lighting. The company offers to supply energy at 1½d. per unit. The matter has been referred to a Committee.

Spain.—La Sociedad Hidro-Electrica del Pindo has lately completed and put in operation a large electric power station and a calcium carbide plant, on the coast of Finistere, near Coruna. Water power is utilised in the generation of the electrical energy.

Sydney (N.S.W.).—The municipal electric light undertaking was inaugurated on July 8th last, and for the following brief description of the work we are indebted to the Sydney *Daily Telegraph*, in which paper a long account appeared on July 5th. The generating station and offices have been erected at Pyrmont, and the plant contained in the former comprises five Babcock & Wilcox boilers, each of 10,000 lbs. per hour evaporative capacity, at 160 lbs. pressure per sq. in., they are fitted with mechanical stokers, economisers, superheaters, &c. The generating plant consists of two 1,000-h.p., and one 500-h.p. Ferranti engines, coupled to Dick, Kerr three-phase 5,200-volt alternators. Separate surface condensers to each engine are installed, and the air and circulating pumps are both motor-driven. In the Town Hall and Lang Park sub-stations, motor generators are installed, three in the former and two in the latter, each set consisting of a 5,000-volt alternating current motor, driving a 480-volt direct current generator, supplying the three-wire low-tension network. The other three sub-stations contain static transformers, reducing down to 240 volts for distribution to consumers for private lighting and the street lamps. The supply of sea water for the condensers is to be obtained through conduits from the Darling Harbour, which, however, were not completed at the beginning of last month. It is stated that this work has been one of great difficulty, owing to the incursions of the tides and the necessity of working in short lengths so as not to interfere with the working of the Harbour railway yard, under which the conduits have been laid. The total length of this conduit amounts to about 600 ft., one-fourth of which had to be cut through rock. The contracts for the various works were let as follows:—Boilers, engines, pipe work, condensers, switchboards, and sub-station machinery, Dick, Kerr & Co., £49,072; supplying and laying of both high and low-tension cables throughout, W. T. Henley's Telegraph Works Co, £39,949; arc lamps and posts, Clyde Engineering Co., £10,399, but Crompton & Co. supplied the arc lamps and switchgear; the building work, including the underground conduit, to various firms at £41,732. The plans for the whole of the buildings and conduits were prepared, and the works carried out, under the direction and supervision of the architect and city building surveyor and the chief draughtsman. Messrs. Preece & Cardew were the consulting engineers to the scheme, and Mr. T. E. Rooke, the resident electrical engineer, supervised the erection of the plant and the laying of the cables.

Several street lighting tests have taken place, and although 217 arc lamps could be lit up, on the recommendation of the electrical engineer, the City Council has resolved to await the completion of the erection of the second engine before commencing a regular supply. The applications for supply received up to July 5th last, represented 665 kw.

Tunbridge Wells.—We give below the principal items shown in the electricity works accounts of the borough for the year ended March 31st last:—

	1904.	1903.
Revenue, private and public lighting ..	£12,491	£11,675
,, meter rents and sundries ..	405	735
Total	£12,896	£12,410
Total works costs, including public lighting	7,808	6,733
Interest	2,369	2,350*
Sinking fund (mortgage and stock)	2,346	2,196†
Net profit on year's working	£373	£1,131
Total works cost per unit	2·19d.	2·18d.
Inclusive average price obtained per unit .	5·62d.	4·02d.

* And special charge. † Stock only.

The number of units sold for all purposes amounted to 853,299, as against 740,148 in the previous year; lamps connected, 52,404; maximum load, 596 KW.

Ware.—The U.D.C. has sealed an agreement with the North Metropolitan Electrical Power Distribution Co. for the transfer of the E.L. order. The company will repay to the Council the cost of obtaining the order (£186), and will sell the undertaking to the Council at the end of 14 years, if desired to do so.

Westhoughton.—The U.D.C. is negotiating with the Lancashire Electric Power Co., the Hulton Colliery Co., and Messrs. J. Musgrave & Sons, for a supply of energy for lighting purposes.

TRAMWAY AND RAILWAY NOTES.

Aberavon.—The T.C. on August 10th approved of the electric tramway scheme from Briton Ferry to Aberavon, submitted by the South Wales Electrical Power Distribution Co.

Aberdare.—Last week the D.C. passed the necessary resolution to promote a Bill in Parliament to enable the Council to construct electric tramways, and also to erect a refuse destructor.

Belfast.—At a meeting of the Tramway Committee of the Corporation last week, the report by Messrs. M'Cowen and Cutler, the city electrical engineer and the city surveyor, was submitted. The report recommended the overhead system of electric traction, and was adopted by a majority. In connection with the purchase, Mr. John Young has been recommended as valuer of the permanent way for the Corporation.

Birmingham.—Good progress is being made with the relaying of new permanent track for the Small Heath route, and it is confidently anticipated that electric cars will be running there in six weeks' time. The Birmingham Tramways Co., Ltd., are extending their Yardley power station to supply current for this route.

British Columbian Railway.—*Reuter* reports from New Westminster that the car-sheds, buildings and plant of the British Columbian Electric Railway, to the value of $50,000, have been destroyed by fire.

Chesterfield.—The work of laying the new electric tramway was commenced on the 8th inst. The lines, when completed, will extend from Storrs Road, Brampton, through the town to Whittington Moor, about 3½ miles. The British Insulated and Helsby Cables, Ltd., have in hand the contract for laying and completely equipping the permanent way, the amount of such contract being £41,258. The tramcars are expected to be running over the whole route within three months of the present date.

King's Norton.—Some heat was displayed at last week's meeting of the U.D.C., when the Chairman of the Tramways Sub-Committee endeavoured to obtain the Council's consent to treat with the Birmingham Corporation alone as to the running of the cars in its area. It was, however, after considerable discussion, determined to await results and compare the company's offer with the Corporation's terms.

L. & Y. Railway (Electrical Section).—Sir George Armytage, in his speech to the half-yearly meeting of shareholders of this railway on 9th inst., referred to the electrified line thus:—"With regard to the electrification of the Liverpool and Southport Railway, the first public trial trip was run from Liverpool to Southport and back on March 22nd of this year, and from the beginning of April up to the present time the number of electric trains run between Liverpool and Southport and Liverpool and Hall Road have been gradually increased from 25 up to 110 trains per day, and more trains are being put on to displace the steam trains as the machinery is handed over to us by the contractors. The whole of the steam and electric machinery is still under their control, but we hope before long they will have it so far complete that our full service of trains can be run. Considering the magnitude of the change and the new problems to be faced which had not hitherto been dealt with by any other railway company, the initial troubles have not been as great as might have been expected, and though there have been some delays to trains which have been inconvenient to some of our customers, the causes of these delays have been tackled one by one and eliminated. The general public has shown its appreciation of the more rapid and more frequent service by travelling in much greater numbers over the railway, our figures for the three months ending June showing that no less than 113,000 additional tickets had been issued. I may also say that the figures for July show an increase of 57,000 passengers over the line. We are unable at present to make any reliable comparison with steam working, but when we have the whole service complete we shall be able to do so."

London.—The number of passengers carried over the recently electrified route of the Metropolitan Electric Tramways, Ltd., for the Bank Holiday week was 353,789, as compared with 198,061 for the corresponding period last year.

Lowestoft.—The T.C., in its first annual statement regarding the electric tramways, established at a cost of £80,000, reported that 2,300,000 passengers had been carried during the year. The receipts exceeded £10,000, yielding a gross profit of £3,334, which was appropriated to interest and sinking fund.

Newcastle-on-Tyne.—Mr. A. E. Le Rossignol, the general manager of the Newcastle Corporation Tramways, has just issued his report to the members of the Council. It states that the result of the second year's working of the tramways shows that the total revenue from all sources is £185,028; the total working expenses of the tramways and of the arc lighting of the city were £121,558, leaving a gross surplus of £63,470. As to the working expenses of the trams, a comparative statement is given which shows that the cost per car-mile was as follows:—

	Year ending March 25th, 1903.	Year ending March 25th, 1904.
Power expenses	·62d.	·58d.
Public lighting	·03d.	·03d.
Traffic expenses	4·03d.	3·97d.
General expenses	·28d.	·24d.
Rates, taxes, &c.	·40d.	·58d.
Maintenance and renewals	·99d.	1·79d.
Total	6·35d.	7·19d.

It will be seen that this year there has been a decrease in all the items making up the working expenses, with the exception of rates, taxes, &c., and maintenance and renewals. Under the former item the department has paid this year over £5,000 in rates, whilst the increase in the latter item is an exceptional one, which has been necessary to keep the plant from depreciating rapidly, and this exceptional expenditure will in the near future save a good deal of heavy renewals, which would otherwise be necessary. The chief increase in the maintenance this year has been incurred in connection with the permanent way and the cars. Out of the gross surplus a larger amount than last year, by over £8,000, has been required for increased interest on, and redemption of, capital. A large amount of this has been spent on work that has been carried out this year, but which has not yet had time to produce revenue, or to come into use. In addition, the charges for interest and redemption on capital unproductive whilst used in the construction of work and not yet ready to yield revenue, have all been paid out of revenue instead of, as is done in many cases, paying these charges out of capital. The amounts paid off entirely in this way, up to date, total £37,463. Had this amount not been paid out of revenue, a slightly heavier rate of redemption would have had to be paid annually, but a larger sum would have been available, out of which a reserve fund could have been formed. The course followed is the better finance, though it has not as prosperous an appearance as a large reserve fund would have. The report suggests a revision of fares. The actual receipts from fares were £180,630 12s. 2d.; the number of miles run, 4,059,907; and passengers carried, 39,715,120. The average receipts per car-mile were 10·68d. The total expenditure on the capital account was £1,054,492 15s. 8d. on March 25th, 1904.

New South Wales.—An Australian exchange says that the electric and steam tram service of the New South Wales Government earned an increase of £51,000 for the financial year ending June, but the expenses were added to by £24,000, leaving a net return of £27,000. The total number of passengers carried during the year was approximately 140,000,000.

New York City.—The sum of $50,000 has been appropriated for the official celebration of the opening of the New York subway system on September 1st. During the day there will be prayers and speeches, the running of special trains, public demonstrations of the advantages of the subway, music at various points, and fireworks in the evening. The portion of the subway to be opened extends from the City Hall, opposite Brooklyn Bridge, to 145th Street, a distance of about 9 miles, or nearly the whole length of Manhattan Island. The extension of the line under the Harlem River into the Borough of the Bronx is promised to be opened on January 1st, 1905.

Perth.—It is stated that the Corporation is experimenting with petrol motor-tramcars, in the hope of avoiding the laying down of a system of electric tramways. Like Wolverhampton, Perth strives after originality.

Poland.—A scheme is under consideration to establish an electric railway, 9 miles long, between Bensine and Dombrowa. The line would connect the large collieries and ironworks in the district.

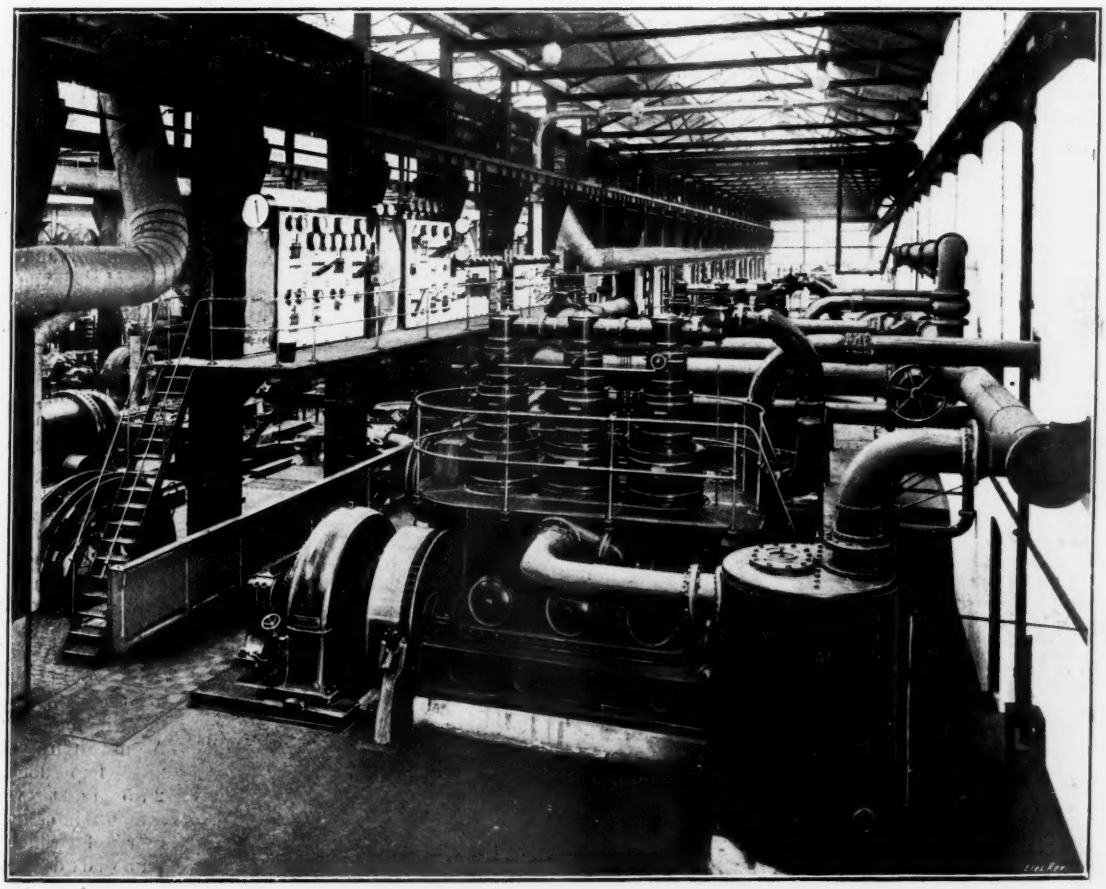
(*Continued on page* 304.)

MESSRS. SIEMENS BROTHERS & CO.'S NEW MANUFACTORY AT STAFFORD.

As our readers are doubtless aware, the well-known firm of Siemens Brothers & Co., Ltd., one of the pioneers of the British electrical engineering industry, has recently erected an entirely new factory at Stafford, for the manufacture of dynamos, alternators, transformers, switchgear, and all other apparatus appertaining to the heavier branches of the industry. The name of the firm has been for the last 40 years inseparably associated with Woolwich, where Messrs. Siemens's large works have been established from the commencement of their activity. From those works have gone forth innumerable electrical machines of all descriptions to the four quarters of the globe, and everywhere they have been regarded as typical examples of the solidarity and thoroughness of British workmanship.

Exterior of Works, from South-West.

As they led the way in the construction of dynamos with drum armatures 20 years ago—and no electrician needs to be reminded that the honour of the invention of that invaluable device, second only in time to that of Gramme, but easily first in importance to the electrical industry, belongs jointly to the Siemens family and Von Hefner Alteneck—so now their products stand in the front rank, and we have reason to believe that recent advances in armature design carried out at



General View of Power Generating Plant and Main Switchboard.

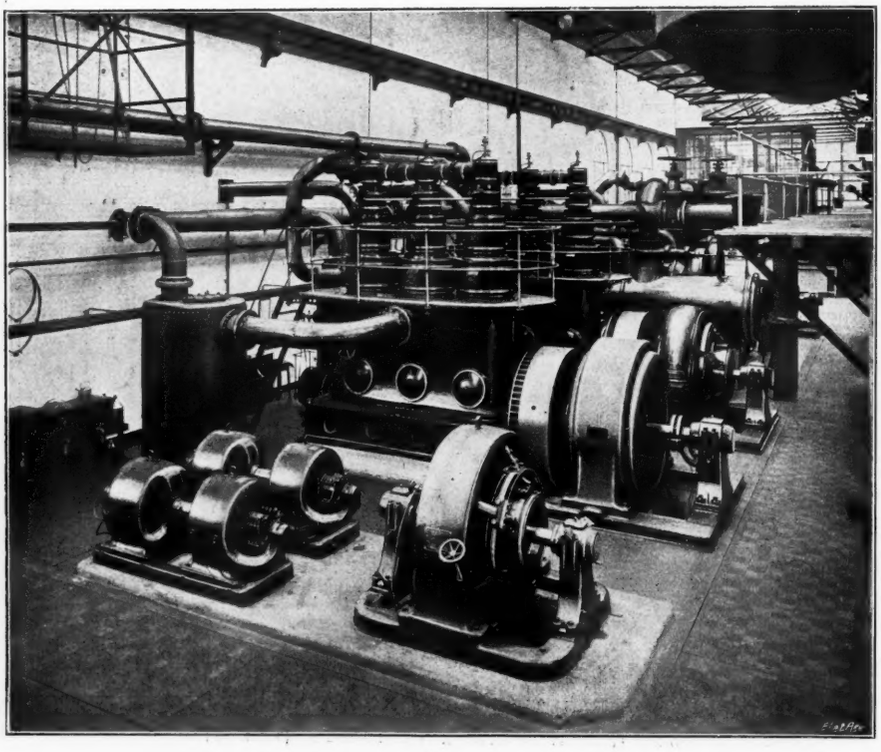
their works will materially modify present-day ideas on the commutation problem.

Messrs. Siemens's reputation does not rest solely upon the industry referred to above; their submarine cable and telegraph factories, and their underground cables for lighting and power, are no less important and in high esteem. We are here concerned, however, with their heavy engineering branch alone.

The reasons for the removal of this manufacturing business from Woolwich to Stafford are varied and numerous; amongst them may be mentioned the necessity for extensions, the urgent need of reorganisation (for, owing to the gradual growth of the original works, the plant was by no means well arranged for economical operation), the lack of railway communications, the high cost of labour in the Metropolitan area, and not least, the onerous restrictions imposed upon manufacturers by the arbitrary and unreasonable regulations of the London County Council. The latter is certainly to be congratulated upon the successful way in which it is driving manufacturing industries into the provinces, thus checking the modern trend from the country to the town, and indirectly benefiting both employer and employed, although it is hardly probable that the Council had any such intention.

Interior of Pattern-Making Shop.

Having resolved to change the scene of their labours, the directors—of whom Messrs. Alexander Siemens, G. von Chauvin and Carl F. von Siemens are the active members—purchased a suitable site on the outskirts of Stafford, affording ample room for extensions, and convenient access to the main line of the L. & N. W. Railway. The buildings, as shown in the view at the head of this article, are situated in pleasant surroundings, a short distance from the town and railway station; besides the works and offices, a number of workmen's cottages have been erected, and we may here mention that every consideration for the comfort and well-being of their employés has been, and is being, shown by the firm. Mess rooms, reading rooms, and lavatories are about to be provided for their use and for the technical staff, and arrangements will be made to supply them with meals, &c., on the lowest possible terms.

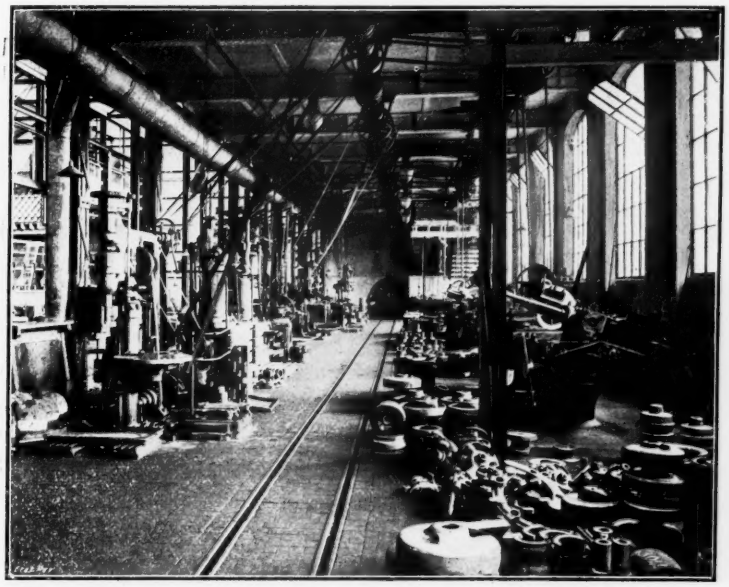


View of Generating Plant, Rotary Converter, &c.

We give on p. 303 a plan of the works, which are built on a site of 50 acres, and comprise, in addition to the offices, the following buildings:—A machine shop, 284 feet long by 275 feet wide, arranged in eight bays, four of which are provided with galleries; an erecting shop, 478 ft. long by 115 ft. wide, arranged in three bays, and provided with an annexe for the boiler house, water purifying plant, &c.; a wood-working shop, 120 ft. long by 100 ft. wide; a small foundry, 80 ft. by 50 ft., completed but not yet in operation; a small gasworks for producing water gas for use in

the shops and in various furnaces, which stands near the west end of the machine shop, and various minor buildings for storing timber, packing-cases, &c.

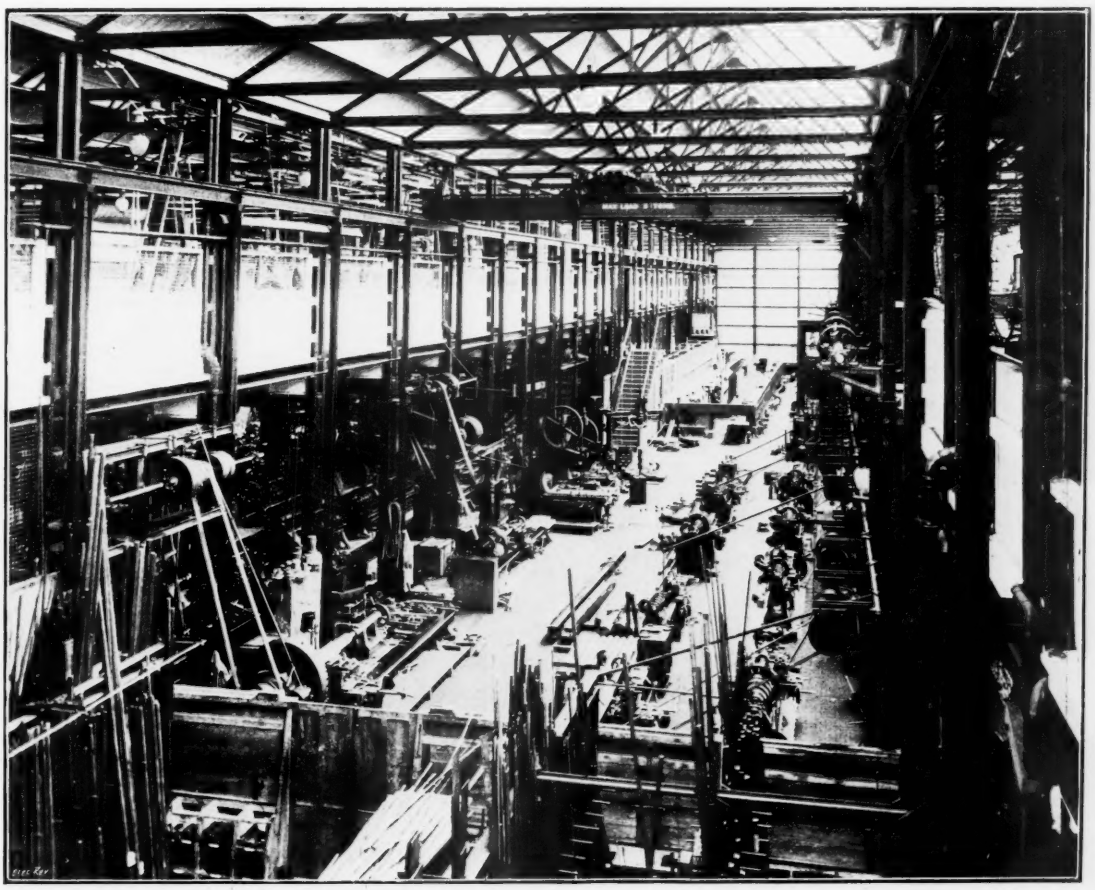
The offices consist of a handsome block detached from the works, and afford accommodation for the accountants' and cost-keeping staff, and separate offices for the heads of departments, on the ground floor; for the joint managers, Messrs. C. F. Jenkin and F. Hird, the technical staff, and the draughtsmen, on the first floor. The building is well-finished and comfortably furnished, and is fitted with steam heating apparatus, and inverted arc lamps for lighting; the drawing office is exceptionally well situated, being lighted from the walls and roof. Fireproof safes are provided for storing all the drawings.



Bay No. 1.—North End of Machine Shops.

From the offices a short walk brings one to the engineering works, which are laid out on the most modern lines, in successive bays, with saw-tooth roofs lighted from the north; trolley lines run down the ends across the whole of the bays, with branch lines down each bay, and these communicate with all the other workshops and with the siding from the main railway line. The shops are so arranged as to involve the minimum of handling of material and finished parts, every item passing continuously forward from start to finish. The roofs are carried on steel columns, and the walls are of brick, except at the west end, which is closed with galvanised iron to facilitate future extensions.

The erecting, testing, and dispatching department is housed in a separate building, beyond the machine shops, and here also the power plant is situated, for convenience both in supervision and in operation; for the same boilers supply steam both to the power plant and to engines on the test bed, whilst the test-room staff can readily attend to the running plant. As the whole of the workshops derive their motive power from this power station, we may commence by a brief description of the plant.

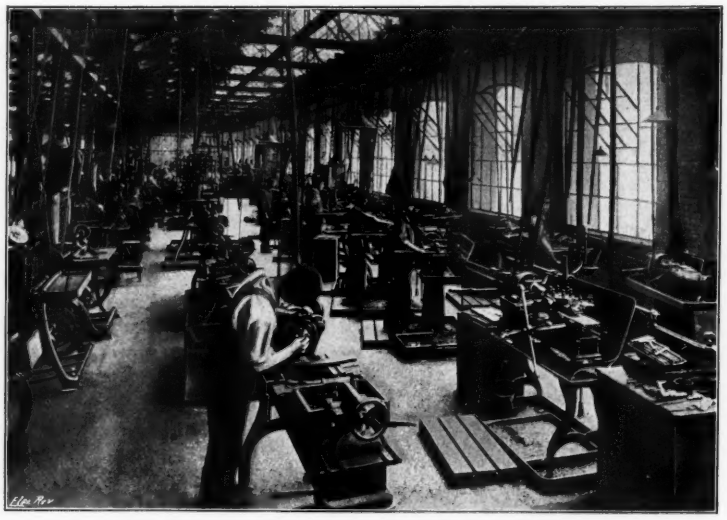


Bay No. 2.—Spindle Shop and Switchboard Erecting Shop.

There are three water-tube boilers, supplied by the Stirling

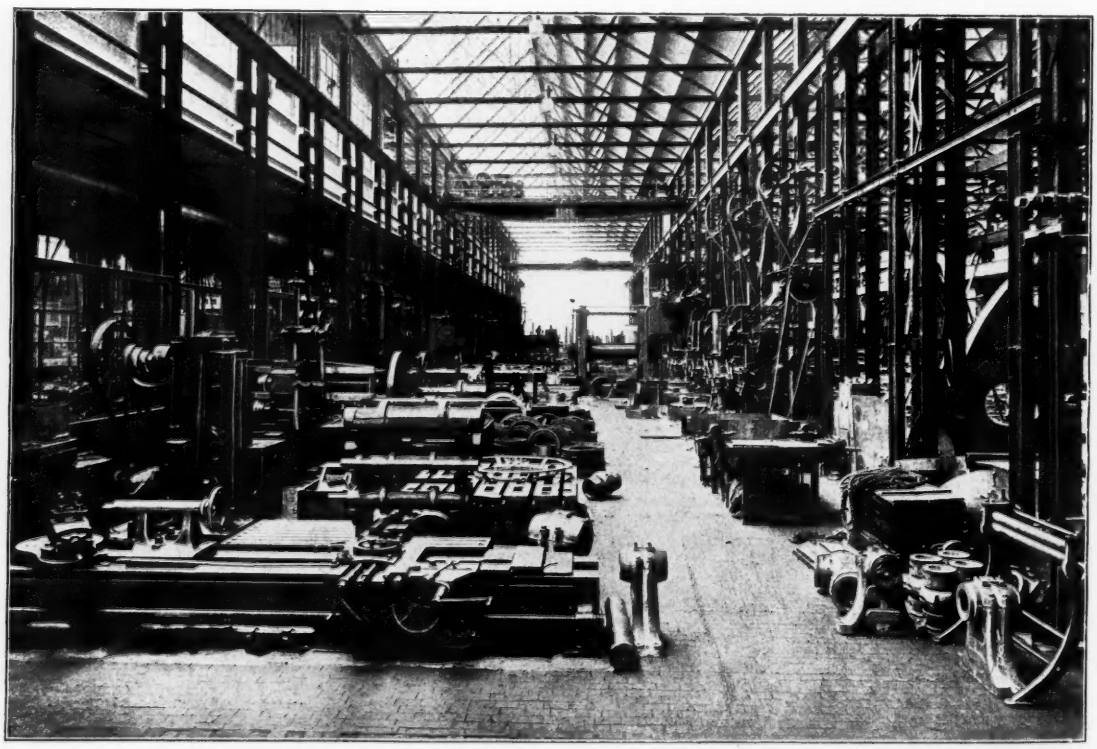
Boiler Co., Ltd., of Edinburgh, each capable of evaporating 17,500 lbs. of water per hour at a pressure of 200 lbs. per sq. in., and provided with superheaters; these are situated outside the building, but are protected by an iron roof. The waste gases are carried off by separate steel chimneys, and, as usual, where Stirling boilers are fitted, no economisers are installed. The feed water, which is of good quality, is heated and softened in a large Boby detartariser, and is supplied to the boilers by means of Weir steam pumps.

The generating plant, of which we give two views, is situated inside the building, close to the boilers, and consists of three Willans-Siemens sets of 250 KW. each. Two of these are direct-current generators, the third a three-phase alternator; a rotary converter provides a link between the two systems, and there are also installed a balancer and a booster set. All the engines are provided with condensing plant, supplied by Messrs. Cole, Marchent & Morley, and consisting of surface condensers, Edwards air pumps, and centrifugal circulating pumps. An ample supply of water for condensing is derived from a cooling pond, situated at the east end of the site. The exhaust steam passes through large oil separators, fitted with baffle plates, on its way to the condensers, and the condensation water is further purified by means of a filter before it is returned to the boilers. Both direct and three-phase currents are used for driving the works, and the switchboard shown in one of the illustrations, mounted on a gallery in front of the generating plant, is equipped with the necessary switchgear to control the whole supply. Shafting carried by the vertical steel columns in the test room, which consists of the middle portion of this long building, is driven by electric motors deriving their power from the plant described above, and serves to drive the machines under test by belting; motors which are being tested can also be belted to this shafting, and various useful combinations can be effected, tending towards economy of energy. A large test bed provides for the testing of the more important machines, and a Belliss compound engine is installed for driving generators when necessary. Further reference to this department may be deferred, until it is reached in the natural order.



Gallery over Bay No. 1, for Turning and Milling.

Having thus, so to speak, set the works in motion, we may commence the round of the shops with the pattern-making and wood-working shops. These are prudently situated at some distance from the machine shops, to guard against fire risks; they consist of two bays separated by a brick wall, one being devoted to general carpentry, packing-case making, &c., the other mainly to pattern-making. The former is equipped with circular and band saws, vertical drills, lathes and planers; these are all belted to shafting fixed beneath the floor in a roomy basement, and driven by a three-phase motor. One of the face-plate lathes, having a 4-in. spindle, is capable of accommodating work up to a diameter of 18 ft.,



Bay No. 4.—Large Lathes and Planers.

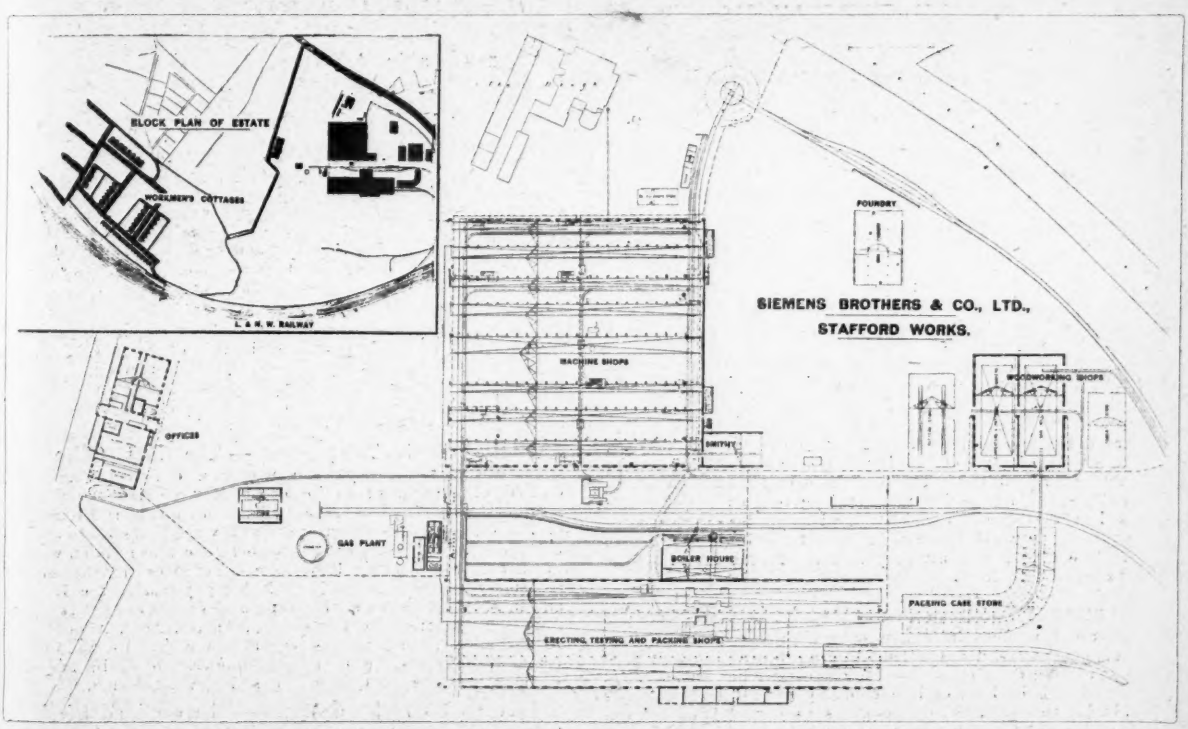
a gap being provided in the floor beneath it. An automatic grinder for plane irons is installed. Trolley lines run into the shops to connect them with the tracks in the yards, and a timber store, with galvanised iron roof, adjoins the carpenters' shop. The pattern shop is equipped with lathes, &c., and a copying machine, driven from overhead countershafting at one end of the shop; there is also a band saw, driven by a separate motor. The copying machine is a tool having a remarkably wide range of usefulness in addition to its special functions; it may be seen in the background of our view of this shop. Of the work shown in the illustration, the field magnet pattern of machine type 36 H is visible in the background, and the stator frame of a high speed (turbine-driven) alternator in the foreground.

Both shops are well lighted from the roofs and walls by day, and with numerous glow lamps by night; and, as in every other department, an office is provided for the foreman and clerical staff within the shop. A pattern store adjoins the pattern shop.

Leaving this department, we may mention that the Hunt Co.'s system of trolley lines is used throughout the shops and yards for points and curves, the trolley wheels being provided with outside flanges, and the points being so

small fittings and parts of switches, and small screws are here produced; the turret lathes are arranged, not in echelon, but in a row with their axes slightly slanting, to give clearance for the rods fed into the machines.

The second bay, which we illustrate, is occupied at the near end by heavy lathes for turning armature spindles; in the middle of the bay will be seen two large band saws, which are used for cutting off pole cores from the rough steel billets, and beyond them are radial drills. At the far end of this bay is the switchboard erecting shop, enclosed by a partition; here a switchboard for Messrs. Stockton & Co. is being erected, and the iron framing of a large board for The English McKenna Process Co. is in place, whilst several others are in progress. By means of an ingenious arrangement of the band saws above mentioned, the pole cores, which are of circular cross-section, are cut off in a curve approximating to the finished bore of the poles, sufficient material being left to provide for slight inaccuracies in position when the cores are cast into the field magnet frames. In cutting the concave end of a core with the band saw, a convex end is left on the succeeding core, which is cast into the frame; this there is practically no loss of material, and the minimum of machining. The curved cut



arranged, with a uniform radius of 12 ft., that the outer trolley wheels ride on the flanges when passing through them, so as to run on a conical path corresponding to the curvature of the track, thus minimising friction and wear. *En route* to the main machine shops we pass the smithy, which contains a power hammer, shears, forges, and the usual accessories.

Commencing at the north end of the machine shops, the first bay is devoted, on the ground floor, to the machining of parts of commutators, brush-holder rings, bearing brackets, end plates, and similar light material; we give a view from the middle towards the west end, showing a number of Gisholt turret lathes on the right hand, shaping and drilling machines on the left. These are driven from counter-shafting. In this and other views, the large iron trunks conveying fresh air (which can be heated in winter) into the shops, with branch outlets near the floor, will be noticed. At the other end of the bay are automatic screwing and other machines, manufacturing bolts of all sizes.

Above this shop is a gallery, equipped with milling machines at the west end, small turning lathes and turret lathes at the east; one of our illustrations shows the latter. Here also the machines are driven through counter-shafting and belts by three-phase induction motors. Brush-holders,

is obtained by the use of two beds, one holding the billet rigidly at the centre of curvature, the other traversing and feeding it to the saw. This bay is served by a 5-ton electrically-driven crane. A feature worthy of notice is the arrangement of the stores, seen in the immediate foreground of the view; the stores are situated along the whole length of the building at the east end of the bays, so that the raw material required in each bay is as near as possible to the machines by which it will be handled. A trolley line runs through the stores, communicating with the general system of tracks.

The next bay is occupied for half its length by the tool room, which is equipped with the best modern machinery for the making of tools, dies, jigs, &c. Lathes, drills, universal grinding machines, a hardening furnace, &c., are here installed, and all the small tools and cutters used in the works are made and ground in this shop, which is run on the usual modern plan, with a staff of expert mechanics. The rest of the bay is used for general turning, bearing brackets, bushes, small spindles, &c. The machines are driven with countershafting by a direct current motor. Over this bay is a gallery used for the manufacture of switches, controllers and resistances; it is equipped with Bardons & Oliver turret lathes, Bickford and Selig-Sonnenthal radial drills, ordinary lathes, a shaper, sensitive drills,

&c. The resistances are made of german silver strips, notched so as to prolong the path of the current, and folded with mica between the folds, so as to give a high resistance in a small volume. This construction has been arrived at after a long period of evolution, and has been found to give most satisfactory results, the resistances being able to stand high overloads without deterioration with time, and to occupy the minimum of space. Punches for notching the strips are installed in this gallery, and other processes, including buffing, copper-plating and lacquering, are also carried on here.

The fourth bay, which is here illustrated, contains boring mills, heavy planers, drilling and tapping machines, &c.; it is used for machining the frames and bed-plates of small motors and generators, large bearing brackets and bushes, armature core end plates, and similar parts, and is traversed by two 10-ton electric cranes. At the west end of the bay there is a furnace heated by gas, with which the white metal for lining bearings is melted.

(*To be concluded.*)

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 298.)

Proposed Kent Coast Electric Railway.—A somewhat extensive scheme for providing an electric coast railway is on foot, it being proposed to construct a trolley line, some 70 miles in length, connecting up the towns of Ramsgate and Hastings, and passing through the following intermediate places—Sandwich, Deal, Walmer, Dover, Folkestone, Shorncliffe Camp, Hythe and Winchelsea. It is pointed out that such a line would have considerable strategic value to the military authorities, as it would connect up the great camps in the south-eastern military districts with many important points on the coast; there might also be expected a large amount of excursion traffic, and facilities for the distribution of goods, produce and parcels in districts at present not served by the railway, are also promised.

Swedish Railways.—H.M. Consul at Stockholm reports that the Swedish Government has entrusted the Royal Railway Board with the task of making experiments with electric motive power on the State railways. The State has, for this purpose, placed at the disposal of the Royal Railway Board a grant of 425,000 kronor (£23,500). The Tomteboda-Vartan and Stockholm-Jarfva lines, near Stockholm, which belong to the State, and have a total length of about 14 kilometres, will serve for the purpose of the experiments, which are to commence at the beginning of next year. The experiments are only intended for the use of single-phase alternating current.

Tramcar Life-Guards.—Last week the three-year old daughter of a warehouseman, named Keogh, ran in front of a tramcar in Manchester, and was killed. The car was at the time proceeding at no greater speed than six or seven miles an hour. It was fitted with the kind of life-guard in use on all the Manchester cars, but, in this case, the cradle seems to have "jumped" the body of the child, which consequently was crushed under the car. At the inquest last Monday, an official from the tramway department informed the Coroner that the Corporation was fitting the cars with a device which, when the cradle was dropped, would keep it down, and so prevent accidents like the present. No blame was attached to the driver, and a verdict of accidental death was returned. At Preston, on Monday, a life-guard of the "cradle" type saved the life of a woman 88 years of age, who had been knocked down by a car. Her injuries were slight.

Walthamstow.—At a special meeting of the District Council held on the 9th inst., it was unanimously decided to ask the consulting engineer (Mr. J. Enright), to bring up a report upon Raworth's automatic regenerative control system.

Wakefield and District.—The electric tramways in the Wakefield district, which have been constructed by the Yorkshire Electric Tramways Construction Syndicate for the Wakefield and District Light Railways Co., were opened to the public on Monday. There are lines from Wakefield to Ossett *vid* Horbury, 5 miles; to Sandal, 1½ miles; to Agbrigg, 1½ miles; and to Stourton, 7 miles. On the Stourton line a connection is effected with the Leeds Corporation's tramways. Lines are sanctioned from Dewsbury to Ossett *vid* Soothill Nether—the local authorities having obtained powers to lay tramways—and when these are made it is hoped to make a connection at Ossett between the Spen Valley and Wakefield systems. There will then be communication between Leeds, Wakefield, Ossett, Dewsbury, Spen Valley, and Bradford. Other lines are in course of construction in the Wakefield district, and it is expected that the tramways, when they are in full working order, will not only prove a boon to the travelling public, but a financial success as well. Mr. H. England, formerly of Sunderland, is manager. It is hoped to maintain a 10-minute service. The cars are similar to those in use in Dewsbury and district. There are already 30 ready for use, each constructed to carry 56 passengers. Each car is fitted with the ordinary hand brake, and a powerful electrical brake. The power station is at Belle Isle, Wakefield. Two generating sets of 400 KW. each have been laid down, and a third set is to be added. In the car shed there is accommodation for 40 cars.

Welsh Electric Railway Scheme.—The Light Railway Commissioners have sanctioned the application to construct an electrical railway connecting Corwen, Bettws-y-coed and Penmachno. The Commissioners stipulate that the promoters must arrange a mutual agreement with Mr. Charles Wynn, who was the only opponent. The new project will cost £130,000, and will extend over 28 miles (2-ft. gauge line) toward Snowdon, and pass through Denbighshire, Merionethshire and Carnarvonshire, tapping districts at present isolated from the railways.

Wolverhampton.—On Wednesday last week, Col. Von Donop, of the Board of Trade, inspected the Bushbury section (1¾ miles) of the tramways. The Corporation has powers to construct another line to the borough boundary at Penn, but it is an open secret that this is to be abandoned. It is suggested that this portion of the borough shall be served by motor-'buses.

TELEGRAPH AND TELEPHONE NOTES.

Amazon Cable Interruptions.—The *India-Rubber World* says that announcement was made on July 20th of the interruption of the cable service between Pará and Manáos, above Itacoatiara. "Such interruptions are so frequent as no longer to possess any novelty, and the service is so irregular as to rob the cable of half its value to commerce on the Amazon. The Amazon Telegraph Co., though put to heavy expense for several years past in keeping their cable in repair, may not be aware of the cause of the interruptions, as explained to the *India-Rubber World* by Captain Arthur Schindelar, a gentleman of long residence and wide observation on the Amazon. According to this authority it is desirable, in the manipulation of rubber prices by the speculative merchants at Pará, to keep buyers of rubber ignorant, as far as possible, of conditions upriver. Hence, whenever prices are to be moved up a few points, the Amazon cable is cut, and deceptive reports are distributed regarding a shortage of stocks at Manáos. This gentleman does not claim to have personally seen any cutting of the cable. Captain Schindelar, by the way, is now visiting the United States for the purpose of interesting capital in a plan for controlling the rubber trade of the Amazon."

Anglo-French Telephones.—The Post Office has announced that a heavy-gauge telephone circuit having been erected between Calais and Lille, some further experiments have been made in telephonic communication between England and the north of France, and it has been found that it will be possible to extend the service. On and from September 1st communication will be practicable between any Post Office call office or the telephone of any subscriber to the Post Office telephone system in the London area and telephone subscribers or persons using call offices in the following places:—Abbeville, Amiens, Aniche, Anor, Armentières, Arras, Bethune, Boulogne-sur-Mer, Calais, Cambrai, Denain, Douay, Dunkirk, Fourmies, Lens, Lille, Masnières, Montreuil, Péronne, Roubaix, St. Omer, St. Quentin, Tourcoing, Valenciennes.

Liverpool Overhead Wires.—The overhead telephone wires which crossed the tramway tracks in Liverpool, and respecting which complaints were made after the fall of wires in February, 1901, have now been placed underground. The work of removing the wires has been carried out by a joint arrangement between the Liverpool Corporation and the National Telephone Co. A few of the trunk wires belonging to the Post Office remain across tracks, in places, but these, it is expected, will be removed shortly.

Sanatorium Accommodation for Post Office Employés.—On Saturday, August 27th, says the *Times*, a conference is to be held at the General Post Office, North, for the purpose of electing a provisional committee in connection with a movement to establish sanatorium accommodation for post office employés.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired
Trinidad-Demerara, No. 1	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Dakar-Konakry	May 13, 1904	
Chio-Ténédos	June 21, 1904	
Paramaribo-Cayenne	July 13, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
All cables—Maldonada-Montevideo	Aug. 12, 1904	Aug. 13
Marseilles-Barcelona	Aug. 16, 1904	
Landlines.		
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 2, 1904	
Moulmein-Bangkok	July 13, 1904	
Caimanera-Santiago	June 15, 1904	
Fao route	Aug. 10, 1904	Aug. 11

The Pacific Cable.—A Government White Paper on the Pacific cable issued last week contains an interesting report by the Pacific Cable Board, of which the *Financial Times* gives the following summary:—

During the year 1903-4 the cable was maintained and remained in efficient working order, and no interruption of any kind occurred. The gross message revenue received during the year was £81,832, and the net message revenue £79,824. The number of messages and words transmitted during the year were 176,351 and 2,095,573 respectively, of which 107,747 messages and 1,226,460 words were inter-colonial. In January last the Fiji Government opened telegraph communication between Suva and Levuka. The actual expenditure of the board on the service of the cable during the 12 months ended March 31st last amounted to £54,824, or £25,000 less than the gross receipts. As, however, the board set aside during the year under review £35,500 as a renewal fund, and as it has also to pay an annuity of £77,544 to meet the interest on its capital and to replace the whole capital in 50 years, the actual deficit amounted to rather more than £88,000, and that sum has to be provided by the contributing Governments. The renewal fund amounted to £52,000, of which £12,500 was held in spare cable. The board hesitates to make any exact forecast of its probable revenue and expenditure during the current year, but if no contingencies arise, it believes that after providing for the annuity, renewal fund, and working expenses, there will be a deficit of £89,810. The board believes that as one result of the construction of the cable and the competition to which it has led, the average time of transmission between Australasia and the United Kingdom has been sensibly reduced. Arrangements have been made for provisioning outlying stations, and the board has endeavoured to supply its officers with rational means of amusement. A post office and a Lloyd's signal station have been instituted on Fanning Island, and if a lighthouse were provided, the board considers that the place would be of value to merchant vessels and the Navy. The board is glad to know that a conference will immediately be held in London between the representatives of the various Governments interested in the cable under the presidency of the Secretary of State for the Colonies, with the object of settling certain matters at issue between them, and believes that the meeting will have the effect of solving many difficulties and indirectly promoting the prosperity of the cable.

The Telephone Service.—In the House of Commons last week, in answer to Mr. Hay, who asked in the event of his coming to an agreement with the National Telephone Co. during the autumn as to the purchase of their undertaking, whether he would give the House an opportunity of discussing the terms of purchase before the Government were committed to the same, in order that the interests of the users of the telephone and the taxpayers might be properly protected, whether he would agree in any event to refer the agreement, if any, to a Select Committee, and whether, in the event of his deciding to postpone the purchase until 1911, he would reduce the rates of the Post Office service, especially the charge for unlimited service—Lord Stanley said: "With regard to the first part of the hon. member's question, I have already pledged myself that no agreement between the Post Office and the National Telephone Co. for purchase of their undertaking will be considered binding until the House of Commons has had an opportunity of expressing its opinion thereon. I have nothing to add to that assurance, except that I am unable to accept the suggestion which the hon. member's question appears to convey, that the Government is not likely to protect the interests of the users of the telephone and the taxpayer. The question of the rates charged for the Post Office service is one that must be considered on its merits apart from any question of purchase."—*Times*.

CONTRACTS OPEN AND CLOSED.

OPEN.

Dublin.—August 23rd. 500 alternating-current meters. See "Official Notices" August 5th.

Hove.—August 30th. Low-pressure mains, conduits, meters, &c. See "Official Notices" August 12th.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Manchester.—August 30th. Wiring and electric lighting of transit sheds at the New Dock Works. See "Official Notices" July 29th.

Roumania.—August 27th. Tenders are being invited until the 27th inst. by the Roumanian State Railway Authorities in Bucharest for the supply and erection of the additional plant required for the supply of electrical energy for lighting and power purposes at the new railway workshops in that city.

Worksop.—August 29th. Underground cables for the U.D.C. See "Official Notices" to-day.

CLOSED.

Acton.—We understand that the Howard Conduit Co., Ltd., of Trafford Park, have secured the order for all the troughing required in connection with the Acton scheme, a contract for which was recently secured by the St. Helen's Cable Co., Ltd.

Bradford.—The Corporation has placed an order with the Hart Accumulator Co., Ltd., for 260 of their standard central lighting type cells, automatic reversible booster, and switch gear.

Bradford.—The Lancashire Dynamo & Motor Co., Ltd., have received an order from the Hart Battery Co. for a large automatic reversible booster for the tramway service.

Greenock.—Messrs. Scott & Co., engineers and shipbuilders, of Greenock, have placed an order with Messrs. W. Sisson & Co., Gloucester, for a four-crank triple-expansion high speed engine, 550 B.H.P., 600 r.p.m.

Hants.—The C.C. has accepted the tenders of Messrs. Dicks & Son, for installing the electric light at the Assize Courts, Magistrates' room, library and cells, at £280, and for alterations to the electric fittings at the Judges' lodgings, at £24.

Johannesburg.—Messrs. W. T. Glover & Co., Ltd., have obtained the contract for supplying and laying their diatrine paper lead-covered, diatrine paper leadless and vulcanised rubber cables, for the Johannesburg municipality. The value of the contract will be considerably over £100,000.

London.—The order for extensions to the electric lighting of the Royal Courts of Justice has been placed with Messrs. F. A. Glover & Co., Ltd., electrical engineers, Garrick Street, Covent Garden.

Mexborough.—The U.D.C. has accepted the following tenders in connection with the E.L. works:—

Babcock & Wilcox, Ltd., pipe work, £118, and steam dryer by Holden and Brooke, £18 1s.; Taylor & Sons, Marsden, Lancashire boiler, £530.

Ossett.—The T.C. has accepted the tender of Messrs. Meldrum Bros. for the supply of an engine, boiler, &c., for the refuse destructor.

Radcliffe.—The D.C. has accepted the tender of Messrs. Etheridge & Clark for the construction of the electric tramways in the district, for £7,930.

Russia.—The Western Electric Co., of Chicago, U.S.A., has secured a contract for the installation of a telephone exchange at Petersburg, Russia, to accommodate 40,000 subscribers.

Stalybridge.—Messrs. Pollock & Macnab, Ltd., Bredbury, have received an order from the Stalybridge, Hyde, Dukinfield, and Mossley Tramways and Electricity Board, for machine tools for the car shed, at £410 10s.

Sunderland.—At the meeting of the T.C. on the 10th inst., the tender of Messrs. J. H. Holmes & Co., for two battery motor-generators, was accepted.

Sunderland.—The question of British *v.* Foreign contracts formed the subject of a lengthy debate at the meeting of the T.C. on the 10th inst. The Electricity and Lighting Committee recommended "that the tender of the Electrical Co., Ltd., for the supply of a motor-generator be accepted." The acceptance of the tender had been somewhat delayed in order that the borough electrical engineer (Mr. J. F. C. Snell) might go into the matter of the tenders very carefully to see if it was not possible without positive extravagance to accept the offer of one of the English companies in preference to the foreign, which was the lowest. Alderman Bruce, in moving the adoption of the report, said the tender of the Electrical Co., Ltd., was for a motor-generator similar to those they already had installed, and Mr. Snell was of opinion that there was a great advantage in having the second lot of plant designed by the same designers as the first. The price also was lower. Councillor Annison moved that the clause referring to the tender be referred back to the Committee. He explained that at the last Committee meeting the attendance was small, and three voted for keeping the order in this country and five for it going to Berlin. At the last meeting the engineer had reported that if the Committee were willing to sacrifice the £100 difference in tenders he could support the making of the machinery by the English firm

so far as quality was concerned. The three lowest tenders were:—Berlin Electric Co., Ltd., £1,500; Messrs. Mather & Platt, £1,600; and Messrs. Dick, Kerr & Co., £1,650. He thought it was time they stopped the money going out of the country as it had been doing of late. In regard to the Berlin tender, the North-Eastern Engineering Works would supply one-seventh of it in the form of a casting, but that was only a small part of the whole, and he did think that it was time they helped their own manufactures. On a division, only 8 voted for the amendment, while 40 supported the report, which was accordingly carried.

NOTES.

American Visit of the I.E.E.—The official programme of the Institution has now come to hand, and gives abundant particulars of every description relating to the tour and kindred matters. A map is given, showing the itinerary which has been arranged, and which must be admitted to be comprehensive enough to satisfy the most insatiate globe-trotter. The tour commences at Euston on Thursday next, August 25th, when a special train leaves for Liverpool to connect with the White Star s.s. *Republic*. Arriving at Boston on September 2nd, the party will visit the local power stations and colleges prior to starting for New York on the following day. On the 4th, a Sunday, Messrs. J. G. White & Co. will take the whole of the party on a steamboat excursion. On Monday the members will secure their return tickets, incidentally visiting the electrical power stations of the city, and will be entertained at a reception and dinner in the evening by the American Institute of Electrical Engineers. On Tuesday the party proceeds to Schenectady, to visit the works of the General Electric Co., by whom the guests will be entertained. Travelling by night to Montreal, the local power plants and the McGill University will be visited on Wednesday and Thursday. Again travelling by night, the party reaches Niagara on Friday morning, where there is an abundance of important power houses and manufactories to be inspected. Another night journey brings the visitors to Chicago on Saturday morning, and after the usual inspections the party leaves for Springfield (once more travelling by night) to visit the tomb of President Lincoln, the day being Sunday. St. Louis will be reached at noon on the same day.

On Monday, September 12th, the International Electrical Congress will be opened in the Music Hall of the Coliseum, and will continue until Saturday, September 17th. The Annual Convention of the American Inst.E.E. opens on Wednesday, September 14th, and after the address of the President, Mr. Bion J. Arnold, a joint discussion by the American and British Institutions on alternating current systems for electric railway traction will take place. The meetings will close at 1 p.m. each day, allowing members opportunities to visit the Louisiana Purchase Exposition.

At 8 p.m. on Saturday, the 17th, the visitors will leave for Pittsburg, arriving there at 3 p.m. next day. On Monday the Westinghouse Electric and Manufacturing Co.'s works will be inspected, and their hospitality enjoyed. The party next proceeds to Washington by another night journey, and will there visit the United States Bureau of Standards and other local features of interest. Travelling by night to Philadelphia, the visitors will, on Wednesday, the 21st, be shown further power stations and points of interest, and will arrive at New York that evening. Thursday is an "off day," and on Friday the party breaks up, the majority sailing from New York by the White Star s.s. *Arabic*. No date is given for their arrival in this country, but we trust that the fates will be gracious.

The President and Council express their warmest thanks to the President and Council of the American Institute of Electrical Engineers for their kind invitation and hospitable provision, and especially to Mr. J. W. Lieb, jun., Mr. Calvin W. Rice, and Mr. Ralph W. Pope, for the admirable arrangements made for the comfort and entertainment of the party.

Papers will be read at the Congress by Col. Crompton, Sir Oliver Lodge, Sir William Preece, Prof. J. A. Fleming, Prof. S. P. Thompson, Messrs. S. O. Cowper-Coles, Philip Dawson, W. M. Mordey, J. Swinburne, and Arthur Wright, while an enormous number of papers will be read by members of the American Institute. Up to June 22nd 1,778 persons had signified their "adhesion" to the Congress, and 160 papers had been promised. It is certain that the Congress will prove a record success; the only trouble we anticipate relates to the disposal of the huge mass of information fore-shadowed. Members of the Congress may count upon a severe attack of mental indigestion, should they attempt to assimilate the whole of this unprecedented feast of knowledge.

Electric Haulage on Canals.—It is several months since experiments were made on the Teltow canal in the vicinity of Berlin, with the object of gaining experience in connection with the projected working of the canal traffic by electricity. It is now announced that the Siemens-Schuckert Works Co. has been entrusted with the order for the supply of the lighting and power plant for the canal, together with the electric locomotives for hauling purposes. The generating station will also supply current for the neighbouring communes, and it is intended to operate both passenger and cargo boats on the canal, which is expected to be well patronised by excursionists in pleasure boats.

Boiler Explosions in Power Stations.—That explosion risks in large boiler plants, not excluding water-tube boiler installations, are by no means so small as popular opinion would seem to indicate, will be gathered from the disastrous explosion which recently occurred at the power station of the St. Louis Traction Co. In this case, evidence seemed to show that a tube in the end boiler of the battery was ruptured, probably through over-heating, and that, due to the action of the out-rushing steam, the boiler was practically torn to pieces; this fractured the second boiler, with similar results, ultimately resulting in the destruction of seven boilers in the row. The boilers each contained 113 tubes 3½ in. in diameter, and 15 ft. 10 in. in length, between the headers; these were joined by two top drums 18 ft. 5 in. long, and 30 in. in diameter, the working pressure being 160 lbs. per sq. in. The explosion wrecked property over an area of 30,000 sq. ft., some of the boiler fragments being hurled distances of 500 ft. away. It also resulted in the death of eight men and injuries to 21 others. Although accidents of this kind are, perhaps, quite unknown in this country, yet it is evident that catastrophes of appalling magnitude are well within the range of possibility, from so simple a cause as a burst boiler tube.

The B.A. Meeting.—There is a large attendance at the Cambridge meeting which is now in progress, the number up to Wednesday evening being 2,600. Prof. Horace Lamb delivered the sectional address in Section A, on Mathematical Analysis, and the Hon. C. A. Parsons in Section C, on Invention. Mr. Balfour moved a vote of thanks in both sections to large gatherings, and Prof. Schroter presented Mr. Parsons with the Grashof Gold Medal and Diploma of the German Society of Engineers in recognition of his work on the steam turbine.

Electricity and the Panama Canal.—The decision to use electrical machinery, as far as possible, in the construction of the Panama Canal, assures us that the engineers in charge are ready to benefit by the latest methods, and that the work of excavation will be carried on as expeditiously as possible. The digging of the Panama Canal seems to offer an unsurpassed opportunity for the free use of electrical machinery and electrical transmission. The work will be scattered over a comparatively long narrow strip of land, but, by means of electrical transmission, power houses which will be economical to operate can be erected, and power distributed efficiently wherever needed. The flexibility of electrical distribution, and the portability of the motors, seem to make this an ideal system for conducting such work. We have no doubt that the other advantages of a large available supply of electric power will be fully realised. In addition to electric lights, the homes, offices and hospitals may be made comfortable by electric ventilating fans, and the camps maintained in excellent sanitary condition by any of the well-known methods of disinfection.—*Electrical Review*, New York.

Orling-Armstrong Recorder.—As we go to press, we learn from the Post Office authorities that our reference on p. 284 to the tests made on their circuit is incorrect. The recording apparatus was not in use, nor was the Wheatstone transmitter employed on that occasion.

Wheatstone's Submarine Cable Recorder.—It is interesting to call to mind, in connection with the article on the Orling-Armstrong recorder appearing on another page, that the last invention upon which Sir Charles Wheatstone was engaged at the time of his death was "a new recording instrument for submarine cables, formed by a globe of mercury moving to and fro in a capillary tube containing acid. It is said to be 58 times more sensitive than any previous recorder." (ELECTRICAL REVIEW, November 15th, 1875, p. 254). Unfortunately, he did not live to develop his invention. It is curious that a somewhat similar device should have been independently brought forward for the same purpose 29 years later.

International Engineering Congress. — From the general programme of the Congress, to be held at St. Louis on October 3rd to 8th, we gather that the Electrical Section is presided over by Mr. F. J. Sprague, M.Am.Soc.C.E., and that papers have been promised as under:—

"The Substitution of Electricity for Steam as a Motive Power," by James G. White, M.Am Soc.C.E., New York City, and Alexander Siemens, M.I.C.E., London, England.

"Electrical Power—Generating Stations and Transmission," by L. B. Stillwell, M.Am.Soc.C.E., New York City.

Among the papers promised in other sections are some dealing with the disposal of Municipal Refuse (Municipal Section) and Underground Railways (Railroad Section), papers being promised by William Barclay Parsons, chief engineer Rapid Transit Commission, New York City; Basil Mott and David Hay, Central London and City and South London Railways; and by M. Briette, assistant engineer of the Metropolitan Railway of Paris. On the Ventilation of Tunnels, Charles S. Churchill, chief engineer, Norfolk and Virginia Railway, and Francis Fox, M.I.C.E., London, have promised papers. Steam Turbines (Mechanical Section), are to be treated by Francis Hodgkinson, M.A.S.M.E., Pittsburg, and M. Rateau. In the Miscellaneous Section, a paper by Prof. W. C. Unwin on Engineering Education is to be noted.

Appointments Vacant.—Resident electrical engineer for Willesden U.D.C., at £250; resident electrical engineer for Hereford, at £200.

Victoria Falls.—From the *Westminster Gazette* we gather that a Mr. W. Barnes (of the I.E.E.) is visiting the above falls for the purpose of determining the practicability of utilising their energy for electrical purposes.

Another Fatality on the North-Eastern.—We regret to learn that on Tuesday a young man named James Harris was killed on the North-Eastern Railway electrical section near Tynemouth. Accompanied by another young man, he was crossing the line in order to reach the seaside, and, it is reported, inadvertently put his foot on the "live" rail. On medical aid being summoned, it was found that he was quite dead.

South African Notes (from our Durban correspondent).—*Johannesburg (Transvaal) Telephones.*—The new telephone system under Government control for Johannesburg has been under consideration for some considerable time; the old one proved long before the war to be incapable of coping with the rapidly-increasing demand for an up-to-date and efficient telephone service. During the war, and for some time after, nothing definite was done owing to the unsettled state of business generally, but plans and specifications were prepared during that time for an entirely new telephone exchange. We now hear that the contract for the complete exchange equipment has been placed with Messrs. L. M. Ericsson & Co., Ltd., Stockholm, Sweden (represented in South Africa by Messrs. Jenkins & Co.), at a cost of about £12,000. The Cape Government, as well as the Natal Government, has adopted Ericcson telephone exchanges and instruments exclusively throughout these colonies, and these telephones are also in use in the new colonies—Transvaal, Orange River Colony, Rhodesia, and Lourenco Marques, and this fact, it is thought, may facilitate the ultimate adoption of telephone intercommunication amongst the different colonies in South Africa. The capacity of the Johannesburg exchange will be 3,600 subscribers, 1,000 being already connected to the present system, and the central exchange consists of three switchboards of 1,200 lines each. The system adopted will be the "ring-through," the same as adopted by the Cape and Natal Governments, which, according to the opinion of the leading telephone experts and engineers, is the most suitable for South African conditions.

Johannesburg (Transvaal).—The Knights Deep Mine, of the Consolidated Gold Mines group, has recently placed an order for pumping plant to deliver 2,000,000 gallons of water per day against a static head of 1,200 ft. The pump is to be of Gould's make, coupled direct to a Westinghouse three-phase induction motor.

Port Natal.—The Natal Government proposes sending home its harbour engineer to consult experts generally as to the future development of the port. It is hoped that a decision will then be arrived at as to the various merits of electric *v.* hydraulic cranes, regarding which there has been much controversy.

The Prospect Hall Estate Co., Ltd., has written to the Town Council stating that it proposes building a tramway about 5 miles long around its estate situated north of the Umgeni River, and to generally make the estate attractive as a residential suburb. The company asks if the Corporation will be willing to meet it in regard to connecting the system with its own. The promoters are prepared to (*a*) build and work that portion of the tramway which will lie within the borough boundaries themselves at their own risk, giving the Corporation the right to expropriate on terms to be agreed on; (*b*) the Corporation itself to build and work the tramway within its own boundaries. They would also be willing to take power from the Corporation electric supply. The matter has been referred to the whole Council in committee.

Tramways and Public Roads.—Just over a month ago a deputation from the Roads Improvement Association waited upon the Board of Trade with reference to certain matters connected with tramways and light railways on public roads, and bridges over railways and canals. The secretary of the Association has now received a letter from the Board, of which the following is an abstract:—

"The Board have carefully considered the representations put forward with regard to the questions of centre poles, width of roads, and bridges over railways and canals, and I am to reply as follows:—

"1. *Centre Poles.*—The Board do not see their way to recommend total prohibition of the use of centre poles, as there might be cases of exceedingly wide roads where such poles might be the best arrangement, or other cases where for some reason centre poles might be necessary. The Board feel, however, the force of the objections stated by the deputation, and will be prepared to enact in tramway and light railway orders that centre poles shall not be used without the express consent of the Board of Trade. They will also communicate with the Parliamentary authorities concerned in private Bill legislation as to the desirability of such a provision. In this way promoters will be required to justify the use of such poles in each case as it arises.

"2. *Width of Roads.*—The Board do not consider that it would be advisable to fix a statutory limit that might have the effect of prohibiting by severance urgently needed lines. In dealing with applications for tramway and light railway powers, the Board always keep in view the 9 ft. 6 in. space referred to in Sec. 9 of the Tramways Act, 1870 (a limit which would appear to be reasonable), and make provision to secure it wherever practicable. The representations made by the deputation on this point will, however, be borne in mind."

NEW COMPANIES REGISTERED.

Generators, Ltd. (81,816).—This company was registered on August 12th, with a capital of £5,000 in £1 shares, to acquire the business carried on at 77 and 78, Trevelyan Buildings, 52, Corporation Street, and elsewhere in Manchester, by J. M. Wallwin, as "Generators," to adopt an agreement with the said vendor, and to carry on the business of electrical and mechanical engineers, electricians, manufacturers, workers and dealers in electricity, motive power and light, generator manufacturers, &c. The first subscribers (each with one share) are:—J. M. Wallwin, 77 and 78, Trevelyan Buildings, 52, Corporation Street, Manchester, electrical engineer; T. W. Sheffield, 77 and 78, Trevelyan Buildings, 52, Corporation Street, Manchester, electrical engineer; H. P. Bagshawe, Moor Grange, Miller's Dale, near Buxton, farmer; H. Bagshawe, Moor Grange, Miller's Dale, near Buxton, farmer; H. Vernon, 402, Great Cheetham Street, East, Higher Broughton, near Manchester, electrical engineer; C. T. Tallent-Bateman, 40, Brazenose Street, Manchester, solicitor; and H. G. Wrigley, 8, King Street, Manchester, solicitor. No initial public issue. The number of directors is not to be less than two nor more than five; the first are T. W. Sheffield and J. M. Wallwin, managing director; qualification (except first directors), £100. Registered office, 77 and 78, Trevelyan Buildings, 52, Corporation Street, Manchester.

Pollak-Virag Telegraph Syndicate, Ltd. (81,819).—This company was registered on August 12th, with a capital of £2,500 in £1 shares (300 founders'), to establish, work, manage, control and regulate telegraph and telephone exchanges, &c., to carry on the business of a telegraph, telephone, electric light, heat and power supply company, and to adopt an agreement with H. Strakosch. The first subscribers (each with one ordinary share) are:—E. O. Goss, 30, Copthall Avenue, E.C., solicitor; H. E. Strakosch, 20, Bishopsgate Street Within, E.C., managing director of A. Goerz & Co., Ltd.; R. Wildner, 20, Bishopsgate Street Within, E.C., clerk; A. G. Mount, 17, Ickburgh Road, Clapton, N.E., clerk; J. Sims, 69, Albert Palace Mansions, S.W., clerk; J. F. Sweeting, 3, Belvoir Road, Dulwich, S.E., clerk; and S. A. Sharpe, 205, Friern Road, Dulwich, S.E., cashier. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, 50 shares; remuneration, £70 per annum, divisible. Registered office, 120, Bishopsgate Street Within, E.C.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—On the occasion of his recent marriage, Mr. J. F. MAGORIS, the chief assistant city electrical engineer at Hull, was presented on Friday last by the clerical, engineering, and works staff of the Corporation Electricity Works, with a handsome case of cutlery. The presentation was made in the presence of the whole of the staff, who, through their spokesman, Mr. G. SYKES, took the opportunity of wishing him and Mrs. Magoris long life and every possible happiness, and, in parenthesis, touched upon the cordiality which had always existed between themselves and their chiefs, Messrs. H. BELL (city electrical engineer) and J. F. MAGORIS.

The salary of Mr. SENIOR, the electrical engineer to the Mexborough Urban District Council, has been increased by £20 per annum.

The Kilmarnock T.C. has appointed Mr. BURBIDGE, engineer under Messrs. Kennedy & Jenkin, who are supervising the carrying out of the electrical undertaking in the burgh, to the position of engineer and manager of the electric lighting and tramways system on an engagement for three years, commencing at £320, and rising by £30 annually.

The Acton D.C. on Tuesday received a report from the Electricity Committee stating that there were 96 applications for the appointment of resident electrical engineer, and the following four had been selected to attend the meeting:—Messrs. J. Martin Blair, Plumstead; T. Bruton, Caterham; G. H. Carter, Heckmondwike; and W. Mackintosh, Keighley. After interviewing the candidates, Mr. CARTER, who is at present resident electrical engineer to the Heckmondwike Council, was appointed to the post at £200 per annum, with residence, coal and lighting.

Electric Tramway Officials.—Out of 87 applicants for the post of tramways manager and engineer at Huddersfield, the following have been selected to meet the Tramways Committee on August 29th:—Mr. A. G. Livesey, assistant engineer, Leeds; Mr. R. H. Wilkinson, general manager at Oldham; Mr. Jas. Smith, borough electrical engineer, Keighley; Mr. John R. Williams, chief engineer-in-charge and station superintendent, Sheffield; Mr. G. R. Blackburn, tramways electrical engineer and works manager, Bradford; Mr. T. R. Whitehead, general manager and engineer, Coventry; Mr. E. H. Edwards, resident engineer and manager to the South Lancashire Tramways Co.

Mr. H. N. THOMAS, having resigned the position of tramway manager under the Huddersfield Corporation in order to take up a similar position under the Durban municipal authority, was last week presented by the chief officials of the Huddersfield Corporation with a handsome dressing case.

Obituary.—We regret to have to record the death, which occurred on 9th inst., at Ealing, of Dr. JOSEPH DAVID EVERETT, F.R.S., formerly Professor of Natural Philosophy at Queen's College, Belfast. He was born in 1831, and after many years expended at Glasgow and Nova Scotia, among other places, in the study and teaching of mathematics, in 1867 he received the Belfast professorship just referred to. That post he occupied for 30 years. In its obituary notice of Dr. Everett's life and work, the *Times*

mentions that he was elected F.R.S. in 1879, and F.R.S.E. in 1862. Dr. Everett was for many years secretary to the Underground Temperature Committee of the British Association, and directed the observations taken for determining the rate at which temperature increases downwards in the earth. In 1871 he moved the appointment of a committee of the British Association for the selection and naming of dynamical and electrical units, and in 1873 drafted a report in which the terms "dyne," "erg," and "C.G.S. unit" were introduced at his suggestion. His "Illustration of the C.G.S. System" was translated into many languages.

General.—We learn that Messrs. Hewitt & Rhodes, consulting engineers, Manchester, have dissolved partnership. Dr. W. G. Rhodes will continue to practice as a consulting electrical engineer at Tower Chambers, Brown Street, Manchester. Dr. Rhodes has long been a valued contributor to our columns, though latterly the pressure of

—	Huddersfield.	Southampton.	Blackpool.	Ilford U.D.C.*	Chester.†
For 12 months ending	March 31st, 1904.	March 31st, 1904.	March 31st., 1904.	Mar. 31st, 1904.	Mar. 25th, 1904.
Length of route	28	10	12‡	6·5	2·5
Total length of track	35	17	21	10½	4·75
Average number of cars in use	44	42	23	—	8·7
Car-miles run per annum	1,632,000 (1,321,929)	1 144,350 (958,502)	735,103 (784,443)	577,034	260,785
Passengers carried per annum	11,899,287 (9,738,213)	9,890,952 (9,446,308)	6,357,218 (6,169,121)	5,274,025	2,002,835
Capital expended to date	£411,390	£198,621	£267,332	£132,874	£66,098
Traffic receipts	£63,700	£51,863	£41,357	£22,588	£8,881
Total ,,	£65,674	£53,501	£42,572	£23,218	£8,916
Working expenses	£34,456	£36,640	£27,874	£13,568	£5,332
Gross profit	£31,218	£16,861	£14,698	£9,650	£3,584
Income per car-mile	9·66d. (10·28d.)	11·22d. (12·89d.)	13·9d. (13·0d.)	9·65d.	8·20d.
Working expenses per car-mile	5·06d. (5·75d.)	7·69d. (7·90d.)	9·1d. (8·1d.)	5·64d.	4·90d.
Interest & sinking fund per car-mile	3·57d. (4·62d.)	2·23d. (2·26d.)	4·5d. (3·6d.)	2·34d.	2·99d.
Total expenses per car-mile	8·63d. (10·37d.)	9·92d. (10·16d.)	13·6d. (11·7d.)	7·98d.	7·89d.
Profit or loss per car-mile	+ 1·03d. (—·09d.)	+ 1·30d. (2·73d.)	+ ·3d. (1·3d.)	+ 1·67d.	+ ·31d.
Cost of energy per car-mile	·47d. (·48d.)	2·55d.	2·5d.	1·54d.	1·60d.
Average fare per passenger	1·28d.	1·26d.	1·43d.	1·02d.	1·06d.
Revenue per mile of route	£2,345	£5,350	£3,548 (£4,450)§	£3,572	£3,566
Expenditure per mile of route	£1,230	£3,664	£2,323 (£2,934)	£2,087	£2,133
Total units used	2,565.643	1,298,392	1,008,529	585,041‖	239,072
Units used per car-mile	1·57	1·13	1·37	1·00	·92
P'rc'ntage of working ex'es to receipts	52·5	68	65·5	60	60

Last year's figures are given in parentheses. * First year of working. † First 11½ months working. ‡ 2½ miles lease to company.
§ Neglecting leased portions. ‖ Includes 10,880 units used on water cart.

Profit Statements.—	Huddersfield.	Southampton.	Blackpool.	Ilford U.D.C.*	Chester.†
Interest on loans	£13,632	£5,935	£13,666	£3,345	£2,026
Sinking fund	£10,638	£4,720		£2291	£1,218
Surplus	£6,948	£6,206	£1,032	£4,571	£340
				Bt. forwd. — £557	
Gross profit	£31,218	£16,861	£14,698	£9,650	£3,584

his professional engagements has rendered his contributions less frequent than we could have wished. We wish him all success.

We are informed that Mr. C. A. Hughes and Mr. Adolph Wunderlick are retiring from the Charlton works of Messrs. Johnson & Phillips after 15 and 7 years' service respectively, having held the positions of works secretary and departmental managers. We understand they are shortly to commence business on their own accounts as electrical manufacturers.

On 12th inst., at Aberdeen, Mr. Alexander Spence, chief of the electrical department of Sir Wm. Arrol & Co., Ltd., was married to Miss Jessie Paterson.

ELECTRIC TRAMWAY ACCOUNTS.

Huddersfield, Southampton, Blackpool, Ilford U.D.C. and Chester Tramways.

We give herewith a further series of tramway returns for the period ending March last. The Huddersfield undertaking is of the probably the most interesting, if only by reason of its extensive route mileage through comparatively thinly populated districts. This, coupled with heavy capital expenditure, has called for skilful and enterprising management, the results of which are shown in the improved position of the undertaking this year. The chief points are the considerable decrease in working and financial expenditure per car-mile, resulting in a profit of over a 1d. per car-mile as compared with a slight loss in the previous year. Following out the practice of previous years, depreciation to the extent of 3 per cent. on capital expenditure has been provided, amounting to £11,687, the surplus providing £6,948, and the balance being charged to the rates. Mr. H. N. Thomas, who acted as manager during the period under review, is taking up a similar position in South Africa.

Southampton, being possessed of high average earning powers, a surplus of over £6,000 was made; working expenses per car-mile are, however, above the average, the item for power (purchased from the lighting department), 2·55d. per car-mile, being higher than that for financial charges. The surplus was allocated as £5,000 in aid of the rates, £1,167 capital expenditure out of revenue, and the diminutive balance, £40, to depreciation. Mr. G. Simpson is the tramways manager.

Blackpool's holiday reputation is reflected in its healthy earnings per car-mile; unfortunately, both working and financial charges are on an extravagant scale, together amounting to 13·6d. per car-mile, and a comparatively small surplus results. It will be noted that the item for energy (purchased from the electricity department) per car-mile, is practically as high as in the case of Southampton. The surplus was applied to covering certain constructional expenses, an a small balance of £53 carried forward. Mr. J. Lancaster is the tramways manager.

The remaining undertakings, Ilford and Chester, are new-comers, and their returns show normal and creditable results; the former earns a substantial surplus, amounting to £4,571 (inclusive of £557 refunded by the lighting department); the latter city, does not offer great prospects from a tramway standpoint, and this is reflected in the small income per car-mile. However, with working expenses under 5d., and financial charges equally reasonable per car-mile, the management is to be congratulated on a satisfactory start. The surplus of £340 is carried forward. Mr. G. R. Spurr is the Ilford tramways manager, and Mr. S. E. Britton is the recently appointed manager and engineer at Chester, in succession to Mr. Thursfield resigned.

CITY NOTES.

Kalgoorlie Electric Power and Lighting Corporation.

The report for 1903, to be submitted at the meeting on 23rd inst., states that although there has been a steady and increasing demand for power, it must be remembered that most of the small mines in existence when the supply from a central station was in contemplation have either closed down entirely or suspended operations. For this reason the mines now working are nearly all large undertakings, and negotiations are going on with some of these for the sale of the power remaining at the disposal of the company. A profit of £9,336 was earned on the other side after charging all costs of production, maintenance, and other expenses, to keep the plant running in a high state of efficiency. Out of this amount, after providing for debenture interest and London charges, the directors have set aside £1,000 to reserve, written off the whole cost of issue of debentures (£2,525), and reduced the amount standing to debit of preliminary expenses by £1,063. £5,091 has

been added to capital account during the year, and £6,527 expended on transmission lines. Since the date of the last report, 8,000 ft. of new pole lines have been constructed, and some 190,250 ft. of transmission wire erected, making a total at the end of April, of about 35,000 ft. of pole lines and 286,850 ft. of overhead cable erected. Since the date to which the accounts are made up, £2,982 has been received on account of calls, reducing the amount now owing to £1,949; £7,615 has been paid off the bank overdraft, which now stands at £1,134, and off the item of bills payable, £3,411 has been paid, reducing the amount now owing to £1,489. The power sales for the current year up to the date of the last return show a very material increase—namely, 95 per cent. over the corresponding period of 1903.

Great Northern and City Railway Co.

Sir Chas. Scotter presided at the half-yearly meeting held at Westminster Palace Hotel on Monday. In moving the adoption of the report (Electrical Review, August 12th), which he described as a straightforward document, he said that the line was opened as early as possible after the Board of Trade consent was obtained, and there was no flourish of trumpets or great demonstration, with the result that throughout the whole district served it was scarcely known that the line was running. That fact accounted in a large measure for the fact that the traffic had not been so good as anticipated. Nothing could be more satisfactory than the actual working of the railway had been. There had been only one interruption of traffic; it caused a delay of 30 minutes, and was due, so far as they had been able to judge, entirely to rats having eaten the rubber insulation off the signal cables under the signal cabin at Moorgate Street Station, thus causing a short-circuit. This rendered the signals inoperative, and the traffic was stopped for a few minutes while the cables were being isolated. There had also been one other slight delay. He was certain that no other tube railway had been able to show such a result as that for its first six months' working. The train service during the busy times of the day consisted of 11 trains of three or four vehicles—they had not found it necessary to run more than four yet, as they were very large. The number of trains in and out of the termini in an hour was about 24, and the interval between the trains during busy times was only 2½ minutes. The time of the journey from Moorgate Street to Finsbury Park was only 13 minutes, instead of 14 as formerly announced. For operating the present service they used about 41 coaches, but they had a total of 58 in stock, so that they were amply prepared for future increases in traffic. In the middle of the day they found they did not want four coaches, and they had made arrangements to run two. Two of those two-coach trains were now in operation; two more would be put into service early next month; and two more by the end of September; and this they expected would effect a very substantial reduction in the working cost. In regard to the ventilation of the line, their large tunnels were very helpful, and during the recent abnormally hot weather the temperature in their tubes had not risen above 60 deg. If people only knew that, they would flock to the railway on the hot days, just for a change. They had a medical officer whose duty it was to take constant samples of the air in the tunnel, and the result of every experiment that he had made had been eminently satisfactory. Their power house plant had never yet worked up to its full capacity. At the present time, during the busy periods, only two of their large engines were running at about 60 per cent. of their output, and during the slack time of the day one engine was only working at 75 per cent. of its output, so that in addition to a reserve of rolling stock they had a reserve of power to cope with an enormous increase in traffic without any further capital outlay. They were generating a Board of Trade unit for slightly under 4 lbs. of coal per hour, and the cost of generating at present, including all charges except depreciation, but including maintenance, was slightly under ½d. per unit. This result reflected the highest credit upon their electrician, Mr. Brousson, and their traffic manager, who had gone into that scheme with a desire and determination to work the line safely and economically, and had eminently succeeded. The receipts had been only £19,356, which they frankly confessed was disappointing, but there was no reason for despondency. As he had said, they had no opening demonstration; and, in the second place, they had had no arrangement with the Great Northern Railway Co, and the traffic on the line was only traffic between Finsbury Park and the City and intermediate stations. They had not touched the great traffic of the Great Northern suburban stations up to the present moment, and yet their traffic was growing well. For the week ending May 26th they carried 140,988 passengers, but for that ended July 7th they carried 157,633. During the last week in June they carried 146,852, and for the week ending August 11th they carried 161,750. The six weeks' total up to June 30th was 819,000, and for the six weeks to August 11th, 961,000. They had already a good traffic from Highbury station, although the lifts would not be finished for another month. He had just heard that all of their difficulties with the Great Northern Railway Co. were settled, and by Monday next they would have the Great Northern Co. working in harmony with them, with through bookings with all their suburban stations, and they would have season tickets available by all three routes, so that a passenger taking a season ticket could travel by the North London, the Metropolitan, or the Great Northern and City. This arrangement would galvanise the line into life, and he hoped into prosperity. In regard to the paragraph in the report respecting the traffic carried by the City and South London after nine years' working, he regretted that the directors of that line had taken slight umbrage, and regarded it as a reflection upon their line. He found, on analysis, that the paragraph was incorrect, and he wished to express regret that it was inserted.

The Earl of Lauderdale seconded the motion, and it was carried.

After a vote of thanks had been accorded to the chairman and directors, the Chairman announced with regret his resignation of his seat on the board, in consequence of his acceptance of the chairmanship of the London and South-Western Railway.

Yorkshire Electric Power Co.

The directors' report, to be submitted to the half-yearly meeting to be held at the Hotel Metropole, Leeds, on Tuesday, August 30th, says that since the last meeting, held in February, 1904, the erection of the power station at Thornhill has made rapid progress. The main buildings are roofed, and the chimneys are completed. The boilers, with their auxiliary machinery, and the engine-house crane, are erected, and will shortly be in working order. Delivery of the electrical plant and the laying of mains has begun. Current will be ready for supply to consumers this year, and contracts for this purpose are being negotiated. An agreement has been sealed with the U.D.C. of Mirfield for the supply of electrical energy in bulk. Under this agreement large power users in this district will receive a supply direct from the company, and economy in working will thus be secured. Bills have been successfully opposed, in this Session of Parliament, promoted by various local authorities seeking powers to supply electricity outside their own areas. The directors trust that the definite lines laid down by the Parliamentary Committee on this matter will tend to hinder such attempts to encroach on the company's area in the future. The accounts of the Yorkshire Electric Power Syndicate, Ltd., have now been closed, and a balance of £223 16s. 2d. has been repaid to the company.

Waterloo and City Railway Co.

Sir Charles Scotter (chairman) presided on Thursday last week, at Waterloo Station, over the twenty-first half-yearly general meeting of the above company, and, in moving the adoption of the report, said that during the past half-year there had been a falling off in the number of passengers carried of 53,783, but this was more than compensated for by the increase of season tickets, which numbered 1,611, against 1,244. The number of daily journeys represented by season tickets in the past six months worked out at 502,632, as against 388,123 in the first half of 1903, so that the apparent decrease of 50,000 turned out to be a net increase of about 60,000. In money there was a small decrease of £147, which was accounted for by the fact that single fares of 2d., and return fares of 3d., were worth more to the company than the season ticket rates. Their line was not exceptional in this respect, because the Central London Railway also reported a decrease in numbers of 200,900, spread over the whole line, and a decrease in money of £2,508. The City and South London Co. reported a decrease of 284,463 in number, exclusive of season ticket holders, and in money taken of £3,802. On the other hand, they had received a larger sum from season tickets. Various causes might account for the falling off on the Waterloo and City line. In the first place, they had had very fine weather during the later months of the half-year, and that, while appreciated, no doubt, by the public, did not conduce to the prosperity of underground railways. Another cause might be attributed to the action of their friends, the South-Eastern Railway Co., who had thought it well to lower their fares between Waterloo Junction and the City. That alteration did not come into force until June 1st last, but it had already had an effect on their takings, and might have still more in the future. Their working expenses for the past half-year worked out at 47·55 per cent., as against 45·59 per cent. on the City and South London line, and 51·42 per cent. on the Central London. A year ago their working expenditure was at the rate of 46 per cent., and the increase this year was entirely due to an unfortunate accident, not to a train, but to a passenger, who met with a serious injury while alighting from a train. But for that unfortunate occurrence, their working expenses would not have shown an increase. While on that subject he would like to say a word in praise of the way in which the line was worked and looked after by the electrical engineer and his staff. Things, of course, went wrong occasionally, but that was very seldom, and when that occurred the delays were very slight. Of course, he knew the working of the line was, strictly speaking, a South-Western matter, but with the knowledge he possessed, the subject was not, he thought, out of place for him, as the chairman of the Waterloo and City Co., to mention it. The accounts sufficiently explained themselves; there was a satisfactory increase of over £80 in rents, and the general charges remained at the same low figure of £222. The result was that they had a balance available for a dividend of £8,521, as against £8,945 a year ago, when they paid 3¼ per cent. On this occasion they could not pay more than 3 per cent., and they carried forward £421 to the current half-year, as compared with £170 a year ago.

Sir Algernon West seconded the motion.

Mr. Stuart asked if the chairman could hold out any hopes of a further reduction in working expenses? He felt that they ought to work more cheaply.

Mr. Laurie was somewhat disappointed with the results. He suggested that some effort should be made to improve the City end of the line. It might be possible to have small cars to run the people up to the street level. He considered that they should have Sunday trains.

The Chairman in reply, said that there were two or three things in the air which were being considered by the directors, and if they could carry them out, he hoped they would reduce the working expenses. As to Sunday trains he had come to the conclusion that there was a good deal in that. Circumstances had changed since the opening of the line, and now that the Central London Railway were running Sunday trains, they might arrange to draw the traffic from the Bayswater district for passengers going to Waterloo to get to the river. As to the City end of the line, the directors had had under consideration the construction of a moving staircase from the railway to the Central London line, but they had found that it would cost £1,000 a year to work it, and that was too expensive. It was a question whether some other means could be found to obviate the inconvenience caused to passengers by having to negotiate the steep incline.

The motion for the adoption of the repor was carried.

British Westinghouse Electric and Manufacturing Co.

Mr. George Westinghouse has issued a statement to holders in the American Westinghouse Co., in connection with a new issue of shares in that company, and he makes the following references to the British Co.:—The British Westinghouse Electric and Manufacturing Co., Ltd., now has authorised capital as follows:—6 per cent. preference shares, £2,500,000; ordinary shares, £750,000; 4 per cent. mortgage debenture stock, £1,462,500. The difficulty of finding a market in England for industrial securities of any character, due to the general depression of trade in that country, rendered necessary the purchase by your company of £500,000 additional preference shares at par, which purchase has recently been completed, and the further purchase of £450,000 at 95 per cent. of par of 4 per cent. mortgage debentures, the payment for which has just been consummated by a credit to your company of £100,000 on current account, covering material supplied, and a payment of the balance in cash. Our investment in the above-named company is now as follows:—4 per cent. mortgage debenture stock, £450,000; 6 per cent. preference shares, £894,020; ordinary shares, £375,460. The latter shares are entitled to three-quarters of the divisible earnings after paying the interest on the debentures and 6 per cent. on both preference and ordinary shares:—

Preliminary Balance-Sheet, April 30th, 1904.

Assets.

Cash, accounts receivable, work in progress, &c. ..	£1,164,032
Plant, tools, &c.	2,042,125
Securities held as investments	254,232
Patents, &c.	808,906
Total	£4,269,295

Liabilities.

Preference shares..	£2,855,000
Ordinary shares	750,000
4 per cent. debenture stock	616,353
Accounts payable, &c.	464,749
Surplus	83,193
Total	£4,269,295

The payment of the balance of £145,000 due April 30th, 1904, on the sale of preference shares and the sale of the remaining £400,000 debenture stock, will give to the treasury of the British company additional cash amounting to £525,000. The property is exceptionally complete and the prospects for a profitable business are excellent, but there will be needed both time and money to carry out so important an operation.

Walter Scott, Ltd.—The directors have declared a final dividend of 6d. each on the ordinary shares, making 5 per cent. for the year ended June 30th last.

South Metropolitan Electric Light and Power Co., Ltd.—The Preference Share Register will be closed from August 17th to August 31st, for the preparation of dividend warrants payable August 31st in connection with the interim dividend for the half-year ended June 30th on 50,000 7 per cent. cumulative preference shares.

Tynemouth and District Electric Traction Co.—The directors have decided to pay an interim dividend for the half-year ended June 30th at the rate of 5 per cent. per annum.

North Metropolitan Tramways.—The half yearly ordinary general meeting of the above company was held on the 18th inst. According to the directors' report, the total receipts during the half year amounted to £309,843, and the working expenses to £299,668, leaving a balance of £10,174. The balance available for distribution allows of a dividend at the rate of 3½ per cent. per annum being paid. The report was adopted.

STOCKS AND SHARES.

Wednesday Evening.

With a certain amount of satisfaction, which is tempered with caution, we are able to set our Stock Exchange tune this week in a major key. For there are cheerfuller conditions to be noted in the lists of prices published overleaf, and while the individual gains are small enough, the quantity in some measure makes up for what is lacking in the quality. Perhaps it is the idea that the Bank Rate may remain for some weeks longer at 3 per cent. which helps to attract the investment purchasers that make for better quotations, and perhaps this same little demand is stimulated by the impression that, after the probable fall of Port Arthur, the end of the war may be brought into sight, with its accompanying promise of restoration of public confidence and business.

Even Central Londons have participated in the better tone, and the Deferred is a point up at 81. The two other stocks are unaltered, allowing for the dividend deductions. The change in the weather is thought likely to have a beneficial effect upon the takes of the Tube companies, but City and South London Ordinary is undeniably flat at 41 *ex* its 1½ per cent. dividend. The lower the price falls, the more selling is thereby produced on behalf of nervous holders, and only by a strong demonstration of support will the falling-sickness become stayed. That the market is fast discounting the bad traffics and other unfavourable factors in the company's case seems to be pretty certain, and if the price gets to about 40, the stock will be worth picking up by those who can buy for the future. Such buyers possibly may think a matter of a point in the price is hardly to be studied.

Expectation will be sorely disappointed if the Great Northern and City Railway does not make rapid strides now that the working arrangement with the Great Northern is an accomplished fact. The price of the 4 per cent. Preferred "A" shares remains at 4½—equivalent to a discount of 57½ per cent.—and the cessation of the traffic publications is a step of debatable policy. For Sir Charles Scotter to be obliged to resign the chairmanship of the company just at the present interesting juncture does seem a pity, although, of course, it is unavoidable. Districts and Metropolitans are 35½ and 92½ respectively. Waterloo and City shows a fall of 2 at 88½, the dividend of 1½ per cent. having been subtracted last week. British Columbia Electric Railway Deferred at 98½, and the Preferred at a couple of points higher, have fallen upon the news that $50,000 worth of buildings and plant have been destroyed by fire, although the damage is covered by insurance.

Of the Electricity Supply shares whose prices recovered the dividends deducted, we may instance Metropolitan Ordinary, Brompton Ordinary and Preference, Charing Cross Ordinary, and the two classes of County of London shares, Charing Cross Preference, at 5½, are ½ easier, the distribution being 2s. 3d. per share. The largest amount is that of Metropolitan Ordinary, viz., 9s. per share, and there is a good deal of business being done in them round about 16, which is practically equal to 22½, cumulative return of capital and the dividend just mentioned. Some of the holders are reinvesting their £6 per share in the purchase of more shares. We hear an unconfirmed rumour that the City of London Co. has signed a contract with the Corporation for the supply of power to the latter for two years. Notting Hills are being vigorously tipped, perhaps it is not surprising that suspicious folk wonder whether someone has a line of shares for sale. In its useful quarterly statement, the Charing Cross Co. reports an increase of sales of current for the first half of this year amounting to 604,864 units, as regards the West End undertaking, and 1,660,606 units as regards the City undertaking. Amongst Debenture stocks, County Seconds are up 1, at 102½, and London Electrics are 2 better, at 97½. The Stock Exchange Official List will probably wake up some day to the fact that the Blackheath and Greenwich Co. has changed its name. Brush Preference at 1½ have added 5s. to their price.

Telegraph and Telephone descriptions have 11 rises to their credit, and no falls. The Anglo-American group has hardened under the leadership of the Deferred stock, which gambling counter is ½ harder at 7½, thanks to the revival in Yankee shares, added to a scarcity of floating supply. The Ordinary and Preferred have both risen a point each. The Eastern varieties so far confine their improvements to the pre-ordinary stocks. Eastern 3½ per cent. Preference advanced 1 to 88½, Eastern and South African Debenture 2 to 100½, and the Mauritius Subsidy Debenture 1 to 101½. West Coast of America Debentures are also a point firmer at 97½, the last-named trio being 4 per cent. stocks, the improvements indicating a modest revival of investment interest in sound securities. Indo-European shares, which went flat at the outbreak of the Russo-Japanese war, have regained their old position, and are £1 better this week, at 44½. The National Telephone issues have commanded support for the Preferred and Deferred stocks, which rose to 105 and 89½ respectively, while better prices are quoted for the new partly-paid Debenture at 66, and the Third Preference shares at 5½.

Traction stocks and shares are fairly active, without displaying much movement. British Electric Preference, at 10⅜, mark ¼ loss, but the dividend deduction is 6s. per share. London United Tramways new Preference have had their special settlement this week, and the price of the shares is 10 9/16, the same as that of the old.

Metropolitan Electric 4½ per cent. Debenture continues to change hands about 98½ and 99, and another section of the electrified line will be opened on Saturday. Anglo-Argentine Tramways Ordinary are being dealt in at 6¼ and thereabouts, the Preference remaining at 5⅜ middle; the traffics for the year to date show a remarkable expansion of £52,313. British Westinghouse Preference at 3, and the Debenture stock at 86½, have not moved upon the publication of Mr. George Westinghouse's statement regarding the finances of the various companies bearing his name.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Aug. 10th.	Closing Quotations Aug. 17th.	Business done week ended Aug. 17th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2¼— 3½	2¼— 3½	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	45 — 48	46 — 49	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	89 — 91	90 — 92	90½	90
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	6½— 7	7 — 7½	7⅜	6½
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5½	5 — 5½	..	..
18,888,300‡	Commercial Cable	£100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	95¼	94½
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
12,931	Direct Spanish Telegraph	..	..	..	..	.. — ..	.. — ..	..	..
6,000	Do. do. 10 % Cum. Pref.	6	..	..	..	7 — 8	7 — 8	..	..
90,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101%	..	..
60,710‡	Direct United States Cable	20	8½%	8½%	3 %	10 — 10⅝	10 — 10⅝	10½	10½
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,300, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	127	125
1,955,566	Do. 8½ % Pref. Stock	100	..	..	..	86 — 89	87 — 90	88½	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	106½	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	11¾— 12¼	11¾— 12¼	12¼	12⅛
820,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	103 —106	103 —106	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	97 —100	99 —102	..	..
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	100 —103	101¼	..
180,227	Globe Telegraph and Trust	10	6¼%	£3 16 7*	5½%	8⅞— 9⅛	8⅞— 9⅛	8⅛	8⅛
180,042	Do. do. 6 % Pref.	10	..	..	..	13¼— 13½	13¼— 13½	13⅛	13⅛
160,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25½— 26½	25½— 26½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	42 — 45	43 — 46	..	..
1,968,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	103 —105	104 —106	105½	104½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	86 — 89	88 — 91	89	86½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	12	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛	5⅛— 5⅜	5⅜	5⅜
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	98½	98½
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	101½	104
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	64 — 66	65 — 67	66¼	66
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6⅜%	⅛— 1/16	⅛— 1/16	1	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6½— 7⅞	6½— 7⅞	..	..
3,808	Submarine Cables Trust	Certs.	..	..	..	118 —123	118 —123	..	..
68,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6½	6 — 6½	6¼	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,809	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	96 — 99	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	12 — 12½	12 — 12⅛	..	..
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102	99 —102	99¾	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 6¾	6½— 6¾	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	..	..
100,000	British Electric Traction	10	9 %	8 %	..	8¾— 9¼	8¾— 9¼	9⅛	8⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10¾— 11⅛	10¾— 11 xd	11⅛	11¼
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	116 —119	116 —119	118¼	117¼
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5¾— 6¼	6¾— 6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	6¼— 6	6¼— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	1/16— 1/8	1/16— 1/8	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— 1	½— 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	¾— 1⅛	1 — 1⅛	1⅛	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
*25,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	71 — 76	71 — 76	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10½	9½— 10½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	..	..
1,960,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	89 — 91	87 — 89 xd	87½	..
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	102 —104	100 —102 xd	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	80 — 82	81	..
1,330,000	City and South London Railway	Stock	2 %	3½%	2¾%	44 — 46	40 — 42 xd	42¾	41½
85,000	Crompton & Co., Nos. 1 to 85,000	8	7½%	5 %	..	1½— 2	1½— 2 xd	..	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	94 — 97	94 — 97	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	¾— ¾	½— ¾	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,023‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000‡	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 83	79 — 83	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	4 %	1 — 1½	1 — 1½	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2 — 2½	2 — 2½	2⅜	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11 — 12	11 — 12	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	5⅛	..
45,200	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	..	..
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3¾— 4⅛	3¾— 3⅞	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	9¾— 10¼	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	35 — 38	35 — 38	36½	35½
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	99 —102	100 —103	100½	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3⅜%	89 — 92	87 — 90 xd	87	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Aug. 10th.	Closing Quotations Aug. 17th.	Business done week ended Aug. 17th, 1904. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	£1	..	..	..	⅝—¾	⅝—¾	..	..
50,000	Do. 7 % Pref.	£1	..	..	..	1⅛—1¼	1⅛—1¼	..	..
100,000	Do. 4½% 1st Deb. Stock	£100	..	..	..	102 —106	102 —106	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	£5	8 %	8 %	10 %	10¾— 11¼	10¾— 11¼ xd	11	..
20,000	Do. do. 7 % Cum. Pref.	£5	..	..	..	10¼— 10¾	10¼— 10¾ xd	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	£100	..	..	..	106 —109	106 —109	106½	..
50,000	Charing Cross and Strand Electricity Supply	£5	10 %	10 %	8 %	7½— 8	7½— 8 xd	7⅝	7 7/16
70,000	Do. do. 4½% Cum. Pref.	£5	..	..	..	5¼— 5½	5¼— 5⅝ xd	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	£5	..	..	..	4¼— 5	4¼— 5	..	..
40,000	Do. do. 1908	£5	..	..	..	4¼— 5	4¼— 5	4 15/16	..
250,000	Do. do. 4 % Deb. Stock Red.	£100	..	..	..	102 —104	102 —104	..	..
44,486	*Chelsea Electricity Supply, Ord.	£5	4 %	4½%	5½%	6¾— 7	6¾— 7	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	£10	5 %	5 %	5 %	10¼— 10¾	10¼— 10¾	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	120 —125	120 —125	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	£100	..	..	..	102 —105	102 —105	103½	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4 %	7¾— 8½	7¾— 8½ xd	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	£10	..	..	..	11 — 12	11 — 12 xd	11 1/16	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	100 —103	101 —104	102½	101½
50,000	Edmundson's Electricity Corporation, Ord. Shares	£5	7 %	7 %	7 %	6 — 6¼	6 — 6¼	6¼	..
80,000	Do. do. 6 % Cum. Pref.	£5	..	..	..	5¾— 6	5¾— 6	6	5¾
140,000	Do. do. 4½% 1st Mort. Deb. Stock	£100	..	..	..	104 —107	104 —107	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£8	..	..	..	1¼— 1⅜	1¼— 1⅜	..	..
49,840	Do. do. do. 6 % Pref.	£5	..	..	..	5 — 5¼	5 — 5¼	5¼	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	94 — 97	96 — 99	97	96¼
100,000	Metropolitan Electric Supply, 1 to 100,000	£10	6¼%	7½%	8½%	15½— 16¼	15½— 16¼	16⅜	15⅞
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid	£5	..	..	..	5¼— 5½	6¼— 6½	5 5/16	5 5/16
230,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	108 —112	109 —113	113	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,853	Notting Hill Electric Lighting	£10	6 %	6 %	6 %	14 — 15	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	14 — 15	14 — 15	..	..
20,000	Do. do. do. 7 % Pref. 20,001 to 40,000	£5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red	£100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	..	2½%	4 %	2¾— 3⅛	2¾— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 88	83 — 88	..	..
65,000	South London Electricity Supply, Ord.	£5	..	1½%	3 %	3¾— 4¼	3¾— 4¼	3 13/16	..
80,000	Urban Electric Supply, Ord.	£5	..	..	..	4¼— 5	4¼— 5	..	..
80,000	Do. do. 5 % Cum. Pref.	£5	..	..	..	4¾— 5¼	4¾— 5¼	5	4 13/16
110,000	Westminster Electric Supply, Ord.	£5	10½%	12 %	13½%	12¼— 13¼	12¼— 13¼	13	12 13/16
28,141	Do. do. 5 % Cum. Pref.	£5	..	..	..	6 — 6½	6 — 6½	..	..

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, August 17th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric .. .. .. per cwt.		5/-	..
a ,, Nitric .. .. per cwt.		22/-	..
a ,, Oxalic .. .. per cwt.		32/-	..
a ,, Sulphuric .. .. .. per cwt.		5/6	..
a Ammoniac, Sal .. .. .. per cwt.		42/-	..
a Ammonia, Muriate (crystal) .. per ton		£33 10	..
a ,, ,, ... per ton		£30	..
a Bleaching powder .. .. .. per ton		£4 10	..
a Bisulphide of Carbon .. .. per ton		£15	..
a Borax .. .. per ton		£13	..
a Benzole (90 %) .. .. .. per gal.		7/-	..
a ,, (50/90 %) .. .. .. per gal.		5/6	..
a Copper Sulphate .. .. .. per ton		£19	20/- dec.
a Lead, Nitrate .. .. .. per ton		£30	..
a ,, White Sugar .. .. .. per ton		£31	..
a ,, Peroxide .. .. .. per ton		£27 10	..
a Methylated Spirit .. .. .. per gal.		2/6	..
a Naphtha, Solvent (90% a 160° C). per gal.		5/6	..
a Potash, Bichromate, in casks .. per lb.		5d.	..
a ,, Caustic (75/80%) .. .. per ton		£24	..
a Shellac .. .. per cwt.		210/-	..
a Sulphate of Magnesia .. .. per ton		£4 10	..
a Sulphur, Sublimed Flowers .. per ton		£6 10	..
a ,, Recovered .. .. per ton		£5 10	..
a ,, Lump .. .. .. per ton		£5	..
a Soda, Caustic (white 70 %) .. per ton		£10 15	..
a ,, Crystals .. .. .. per ton		£9	..
a ,, Bichromate, casks .. .. per lb.		2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots .. per ton		£180	..
b ,, Wire, in ton lots .. per ton		£168	..
b ,, Sheet, in ton lots .. per ton		£166	..
p Babbitt's metal ingots .. .. per ton		£43 to £130	..
c Brass (rolled metal 2" to 12") basis per lb.		6¾d.	..
c ,, Tube (brazed) .. .. per lb.		8¼d.	..
c ,, ,, (solid drawn) .. per lb.		7¼d.	..
c ,, Wire, basis .. .. .. per lb.		6¾d.	..
c Copper Tubes (brazed) .. .. per lb.		9¼d.	..
c ,, ,, (solid drawn) .. per lb.		9¼d.	..
c Copper Bars (best selected .. per ton		£70	..

METALS, &c. (continued).

		Latest Price.	Week's Dec. or Inc.
g Copper Sheet .. .. .. per ton		£70	..
g ,, Rod .. .. .. per ton		£70	..
c ,, (Electrolytic) Bars .. per ton		£62	..
c ,, ,, Sheets .. per ton		£78	..
c ,, ,, Rod .. per ton		£72	..
c ,, ,, H.C. Wire per lb.		7¾d.	..
f Ebonite Rod .. .. .. per lb.		3/3	..
f ,, Sheet .. .. .. per lb.		3/-	..
n German Silver Wire .. .. per lb.		1/6	..
h Gutta-percha fine .. .. .. per lb.		3/-	..
h India-rubber, Para fine .. .. per lb.		5/0½ to 5/2	inc.
i Iron, Charcoal Sheets .. .. per ton		£18	..
i ,, Pig (Cleveland warrants) per ton		43/6	2d. inc.
i ,, Forgings, according to size per ton		From £11	..
i ,, Scrap, heavy .. .. per ton		47/6 to 50/-	..
i ,, Wire, galvanised No. 8 .. per ton		£9 15	..
g Lead, English Ingot .. .. per ton		£12 2 6	..
g ,, ,, Sheet .. .. per ton		£11 17s. 6d.	..
m Manganin Wire No. 28 .. .. per lb.		3/-	..
g Mercury .. .. .. per bot.		£7 17 6	..
d Mica (in original cases) small .. per lb.		6d. to 1/	..
d ,, ,, medium per lb.		2/6 to 4/-	..
d ,, ,, large .. per lb.		4/6 to 8/6	..
p Phosphor Bronze, plain castings per lb.		1/- to 1/2½	..
p ,, rolled bars & rods per lb.		1/- to 1/3	..
p ,, ,, strip & sheet per lb.		From 1/1	..
o Platinum .. .. .. per oz.		£4	..
c Silicium Bronze Wire .. .. per lb.		9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n per ton		£38	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block .. .. per ton		£123 10	..
g ,, Foil .. .. .. per lb.		1/6	..
n ,, Wire, Nos. 1 to 16 .. .. per lb.		1/6½	..
p White Anti-friction Metals— "White Ant" brand .. per ton		£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.		8d.	..
j ,, 6 lea. Flax .. .. .. per lb.		5½d.	..
j ,, 3 ply 10 lbs. Russian .. per lb.		4½d.	..
j ,, 10 lbs. Russian, single .. per lb.		4½d.	..
j ,, 180 lbs. Jute rove .. per ton		£11	..
k Zinc, Sh's (Vieille Montagne brd.) per ton		£25 5	..

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Aug. 6	1,664	+286	10	14,756	+ 3,110	10	—
Bath	,, 10	833	—	33	19,903	—	12½	—
Birmingham ..	,, 18	5,082	+259	33	178,084	+11,579	82	—
Blackburn	,, 12	1,141	+ 33	20	19,687	+ 1,841	18½	—
Blackpool	,, 11	2,558	+ 81	19	23,359	+ 2,606	8½	—
,, —Fleetw'd	,, 13	1,910	—161	6	9,124	— 202	7½	—
,, —Lytham	,, 11	1,050	— 44	41	18,732	+ 6,157	7½	—
Bolton	,, 14	1,885	+ 76	20	37,719	+ 277	25	—
Bournemouth ..	,, 10	1,104	+166	19	22,175	—	10½	—
Bradford	,, 6	5,929	+1021	18	86,795	+18,697	50	—
Brighton	,, 14	1,369	+135	—	21,140	—	9	—
Bristol	,, 12	6,212	+285	—	—	—	28	—
Devonport ..	,, 5	773	+169	31	16,468	+ 2,648	5	—
Dudley—Sto'rb'ge	,, 5	1,606	+ 70	31	26,595	+ 1,064	18½	—
Gateshead ..	,, 5	1,095	+ 53	31	28,047	+ 1,315	10½	+ ½
Gr'n'k—Pt. Glasgw	,, 5	748	+ 92	31	17,550	+ 888	7½	—
Oldham—Ashton	,, 5	615	— 7	31	16,927	— 778	5	—
Potteries	,, 5	1,782	—165	31	52,849	+ 4,288	26½	—
South Staffs. ..	,, 5	1,117	—350	31	24,182	— 2,913	21½	—½
Swansea	,, 5	945	+ 13	31	16,956	+ 986	8½	—
Wolverhampton ..	,, 5	705	+ 77	31	12,161	— 117	10½	+8
Yorks. Wool Dist.	,, 5	751	+194	31	18,574	+ 7,794	6	—
Miscellaneous ..	,, 5	6,696	—	31	103,977	—	—	—
Burnley	,, 13	1,235	+311	—	—	—	10½	+3½
Burton-on-Trent ..	,, 14	418	— 26	19½	7,162	—	6½	—
Cardiff	,, 6	2,813	+216	18	39,085	+ 1,162	14	—
Chatham & District	,, 11	656	+ 10	32	18,842	+ 2,238	9½	—
Cork	,, 11	571	— 75	32	14,854	— 1,806	9	—
Dover	,, 6	370	+ 29	32	6,601	— 255	8	—

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Dublin	Aug. 12	5,378	+115	—	94,496	— 3,881	47	+ ½
East Ham	,, 13	790	+ 75	19	15,181	+ 1,969	5	+ ½
Glasgow	,, 13	14,218	+1421	11	152,651	+ 6,848	71½	+6½
Halifax (2 weeks) ..	,, 10	4,046	+416	19	30,397	+ 2,297	33	+1½
Huddersfield ..	,, 13	1,439	+ 37	19	—	—	26	—
Hull	,, 13	2,190	+345	19	42,033	+ 5,504	13	+2½
Ilkeston	,, 10	151	— 43	19	2,882	—	3·5	—
Ipswich	,, 6	882	—	18	9,704	—	10½	—
Isle of Thanet ..	,, 13	2,072	+307	32	21,031	+ 505	10½	—
Leeds	,, 13	5,334	+105	—	119,736	+ 7,112	81½	+2
Liverpool	July 30	10,953	+ 953	31	318,347	+11,081	103	—
London C. C. ..	Aug. 6	15,919	+3711	18	229,905	+44,966	46½	+6½
Manchester	,, 6	13,930	+671	18	226,311	+ 8,123	131½	—
Newcastle	,, 13	3,563	+132	—	—	—	17	—
Portsmouth	,, 13	2,794	+201	—	41,974	+ 3,922	14½	—
Salford	,, 8	4,342	+176	—	77,881	+ 6,085	30	—
Sheffield	,, 7	5,989	—600	19	91,271	+ 2,244	33	+ ½
Southampton ..	,, 11	1,145	—125	—	—	—	9	—
Southend-on-Sea ..	,, 8	805	+146	18	6,127	— 854	6½	—
Sunderland	,, 7	1,786	— 69	17	24,680	+ 246	21	+1
Tyneside	,, 10	999	— 10	33	12,290	+ 2,085	8·9	+·4
West Ham	,, 11	1,178	—	24	20,357	—	8·62	—
Wolverhampton ..	,, 10	705	+106	—	—	—	9·5	—
Cen. London Rly. ..	,, 13	5,336	—152	6	85,680	— 2,022	6	—
City & S. Lon. Rly.	,, 14	2,314	—118	7	16,275	— 928	6½	—
Dublin—Lucan Rly.	,, 12	141	— 50	6	924	+ 50	6½	—
G. N. and City Ry.	,, 13	984	—	26	24,313	—	3½	—
L'pool Overh'd Rly.	,, 14	1,703	+ 56	7	12,090	— 68	6½	+1½
Mersey Railway ..	,, 13	1,358	+ 74	6	8,686	+ 502	4½	—

* Compared with the corresponding period of 1903.

IRON LOSSES IN DYNAMOS.

[COMMUNICATED.]

Long ago Dr. Fleming showed that the eddy loss in iron per cubic centimetre is represented by

$$W = t^2 n^2 B^2 \frac{m^2}{m^2 + 1} 10^{-16} \text{ watts},$$

where B is maximum induction in the plate,
n is frequency,
t is thickness of plate,
and $m\,t$ = width of plate.

For very wide strips, then,

$$W = t^2 n^2 B^2 10^{-16} \text{ watts}.$$

This law can really only be applied in cases where the flux follows a sine law, to very thin plates, and it takes no account of temperature changes. A rise in temperature reduces the loss by 0·4 per cent. per degree Centigrade.

The above law has been occasionally applied quite indiscriminately to calculate the eddy loss in dynamo armature cores, although it is quite apparent that here the flux is more of the flat-topped type and by no means of the sine variety, while it is further distorted when the machine is under load.

The empirical Steinmetz law for hysteresis, viz., $H = \eta\, n\, B^{1\cdot6}\, 10^7$, where H is loss in watts per cubic centimetre, only applies where B is between 2,000 and 15,000, η varies slightly with the temperature, and the flux is an alternating flux. This law does not really apply to a dynamo armature core at all, since, as was early pointed out by Swinburne, from theoretical considerations, a rotating mass of iron acted on by a field of high induction density is a very different affair to a mass subjected to an alternating flux. This was confirmed by the experiments of Baily and others, on a rotating cylinder, which showed that for solid cylinders the loss is greater than that calculated by Steinmetz's law up to an induction density of 15,000 lines per square centimetre. Above this limit the loss diminishes very rapidly asymptotically, and becomes practically zero for an induction density of 20,000 C.G.S. lines. In hollow cylinders, no doubt, this effect also exists; however, here research is still necessary, in order to show its extent.

Again, with regard to a purely alternating flux the Steinmetz law breaks down entirely for densities of 20,000 C.G.S. lines; the loss in this case, although considerable, is still less than calculated from the law.

As is the case with eddies, a rise of temperature reduces the hysteresis loss. The experiments of Kunz, Morris, and Mills, show that it diminishes directly with temperature, till the critical temperature for the iron specimen is approached.

It appears, therefore, that applying these formulæ to dynamo cores in the expectation of getting an approximately accurate result, is, to say the least, somewhat bold. Besides the fact that the distribution of the flux in the teeth of slotted armatures is practically unknown, the two formulæ take no account whatever of the increased losses due to fluctuations of magnetism caused by teeth, commutation, &c.

As to the hysteresis loss in the core and magnets, due to fluctuations, this appears to be quite beyond the power of calculation.

The eddies in the solid magnets would appear, theoretically, to follow the law (see Prof. J. J. Thomson's calculations, *Electrician*, April 8th, 1892),

$$W = \frac{\sigma\, m\, H^2}{32\, \pi^2} \text{ per centimetre area},$$

where $$m = \left\{\frac{2\,\pi\,\mu\,p}{\sigma}\right\}^{\frac{1}{2}};$$

H is the induction here, and p involves the frequency.

The method of Kapp and Housmann of testing a motor for hysteresis and eddies whereby the law

$$W = a\,n + b\,n^2$$

is derived, is open to the objection that it is a "no-load motor test."

If we include a term $c\,n^{\frac{1}{2}}$ to represent the loss in magnets, then

$$\frac{W}{n} = a + b\,n + c\,n^{-\frac{1}{2}},$$

and since this frequently comes out a straight line, it is argued that the third term is practically zero, and the losses in the solid portions are at any rate very small. However, as has been pointed out, the above expression for loss in solid parts involves μ, the permeability, and assumes it constant, which, with the fluctuations caused by slots, it cannot be. The results of experience also point to the losses in the solid parts of dynamo and motor pole-tips as being fairly considerable. The loss appears also to be greater under load than running light, the flux distribution being entirely altered.

The next empirical law is that of Messrs. Parshall and Hobart, and is used by them successfully in calculating losses in large multipolar machines. Here the total loss is supposed to follow a straight line law varying as $B\,n$ (see "Electric Generators," p. 229). The values of 23 tests are plotted, and the line given as a rough mean. This has since been confirmed to some extent by the research of Esterline and Reid (*Transactions*, American Institute of Electrical Engineers, Vol. XX, 1903, p. 1323), they giving curves which will be very useful to designers of large machines. For small two-pole dynamos the eddy loss for smooth cores seems to follow the 1·9th power of B, so since the slotted core has a greater loss, B^2 is probably followed in this case. Certainly, for small machines, nothing like a total loss following the value $B\,n$ has been observed, so that this probably applies only to very large multipolar machines.

From Messrs. Esterline and Reid's results the curves clearly show that toothed cores within solid poles induce a greater total loss than toothed cores rotating within laminated poles. For instance, a few values are as follows:—

Kilolines per sq. cm. × ~.	Watts per kilogramme.	
	Laminated.	Solid.
100	1	1·25
300	5	6
450	9·5	12
500	11	14

As lamination does not reduce the hysteresis, it is clear the additional loss must be due to eddies in the solid portions. From these results, therefore, it would appear that the straight line boundary in the Kapp and Housmann tests referred to above will not hold for certain frequencies and inductions. With the probably lower inductions and frequencies of small machines, the straight line boundary would probably hold, and it will be represented by

$$\frac{P}{n} = a + K\,n,$$

whereas for larger machines for which windage friction, &c., varies as $n^{1\cdot5}$ and a term varying as $\sqrt{n}$ is to be added, we have for the equation to the boundary

$$\frac{P}{n} = a + b\,n + c\,\sqrt{n} + \frac{d}{\sqrt{n}}$$

assuming core eddies follow the square law, so that in this case, $b\,n + c\,\sqrt{n} + \frac{d}{\sqrt{n}}$, cannot be put equal to $K\,n$, say, and the line is no longer straight. This, however, is not very surprising when the high inductions and slotted cores, now common, are considered.

It appears, therefore, from the above that at present attempts to calculate losses of this sort in dynamo machines are not particularly successful, and owing to the great complexity of the practical aspect of the problem, it seems unlikely that anything better than an empirical method will be arrived at.

However, after all, for designing purposes, this is all that is necessary: a chart to steer by, and a great deal better than the Bellman's "perfect and absolute blank." There are so many things interesting to electrical engineers about which we know very little; there's "electricity," for instance, yet we manage to jog along.

THE PRODUCTION AND UTILISATION OF OZONE.—I.

By JOHN B. C. KERSHAW, F.I.C.

The present writer, in an article published in the Electrical Review of July 29th, 1898, described various forms of ozonisers which had been employed up to that date for the production of ozone in air by the silent electric discharge, and at the end of this article the writer gave a comparison of the yields and costs of ozone, and of active oxygen based on the figures supplied by the patentees from experimental trials with these ozonisers.

In the six years that have elapsed since the former article was published, a considerable amount of experimental work has been carried out in connection with the production and utilisation of ozone or ozonised air, especially as regards its use for water sterilisation, and in the present contribution, the writer proposes to bring the information of the earlier article up to date.

The Andreoli Ozoniser. — This was described in the former article, and no new facts or figures relating to this ozonizer, or to its applications, have come into the writer's hands since 1898.

The Marmier and Abraham Ozoniser.— Fig. 1 is a sectional elevation of the Marmier and Abraham form of ozoniser. A is an air-tight box about 2½ metres in height, containing a number of vertically-placed electrodes, *e e e*. These electrodes are hollow plates of steel, and each carries on its two external faces, plates of glass, *i i i*. The electrodes are placed in the box or chamber A in such a manner that a considerable air space separates each neighbouring pair. The air supply takes place by the central channel O, and the arrows in fig. 1 indicate the direction taken by the air in its passage between the electrodes and out of the chamber, by the passage D.

The hollow electrodes are cooled by a current of water which flows through them, special arrangements being made to avoid short-circuits through the water supply. Current at 40,000 volts is used for this type of ozoniser, and an external spark-gap is employed to minimise the danger from spark formation in the ozoniser. As regards yield, 1 H.P.-hour was stated to produce 20 grammes of ozone, and to ozonise 3·4 cb. metres of air at Lille, while at Marseilles an installation in a brewery is said to be producing a concentration of 12 grammes of ozone per cb. metre of air, with an initial pressure of 30,000 volts and a discharge equivalent to 5 KW. per sq. metre of electrode surface. Installations of this ozoniser for water purification are in use at Lille and at Marseilles.

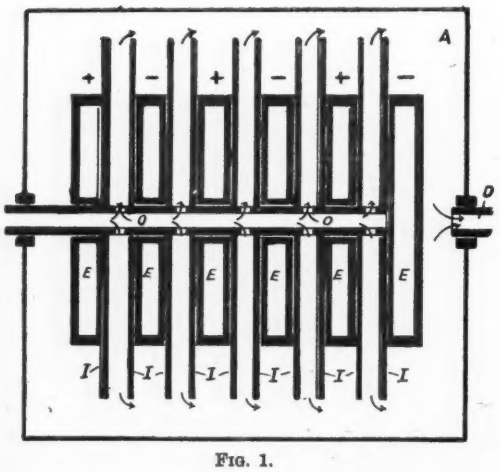
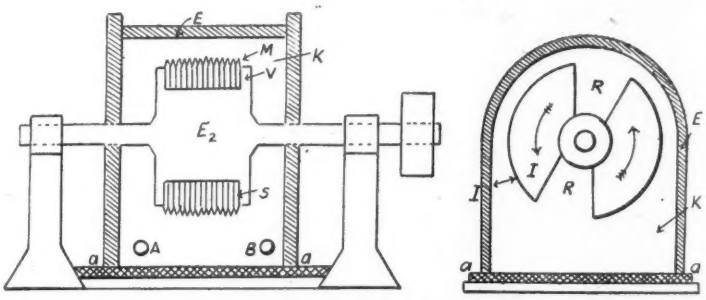


Fig. 1.

Otto's Ozoniser.—The earlier forms of the Otto ozoniser were described in the Electrical Review of July 29th, 1898.

Figs. 2 and 3 are sectional diagrams of Otto's latest form of ozoniser. K is a semi-circular air chamber, with a metal wall, E_1, which forms one electrode. Within this chamber a number of steel disks, S, S, S, are mounted upon a revolving barrel, E_2, the edges of these disks being bevelled, and having the serrated appearance, shown in fig. 2 at M. Each disk has two segments cut out as indicated at R, R (fig. 3), and the plate of insulating material (glass), *a*, *a*, which forms the base of the chamber K, in conjunction with these gaps, effectually destroys any arcs that may strike across the air space, I, I. The air enters the chamber K by B, and passes away at A_1. The rapid rotation of the composite electrode E_2, with its serrated edges, assists in distributing the air through the interior of the ozoniser, before its escape at A. The distance separating the two electrodes should be about 30 mm., and with steel disks 1½ mm. in thickness, having bevelled edges 10 mm. broad, a pressure of 25,000 volts can be employed.

The Otto form of ozoniser is employed at one or two



Figs. 2 and 3.

factories in France in connection with the manufacture of organic products, and the inventor has recently been carrying out some experiments with it at Niagara Falls in relation to water purification. The results obtained in these experiments will be dealt with in the final section of this article.

The Siemens & Halske Ozoniser.—This ozoniser was referred to in the earlier article, but the latest and industrial form of the Siemens & Halske ozoniser is shown in sectional elevation in fig. 4. A is a metal (cast-iron) chamber divided into three compartments, and containing two ozonising units, B, B. Each of these units is made up of an inner metal cylinder, D, D, a slightly larger glass tube, C, C, and an external cylinder or tube of tinfoil or other thin metal, E, E. These two ozonising units are fixed in the central division of the metal chamber, A, and the tubes are surrounded by water, for cooling purposes. Air enters the chamber at O, and passes away at S, the small arrows showing the path it takes through the apparatus. The discharge occurs in the annular space between the inner cylinders, D D, and the inner wall of the glass tubes, C C; an insulating plate of glass, F, being used to avoid short circuits at the floor of the chamber. K is a thick glass plate let into the wall of the middle portion of the chamber for watching the operation of the tube ozonisers, and the arrangements for regulating the water supply are shown at G H. The outer tubes of tin-foil, the water, and all the external parts of the ozoniser are at the potential of the earth, and the risk of shock arising from use of high potential currents, in this form of ozoniser, is reduced to a minimum. As regards yield, in the earlier years of their experiments in this direction, Messrs. Siemens & Halske reported a yield of from 20 to 25 grammes of ozone per E.H P.-hour, and a concentration of 2 grammes of ozone per cubic metre of air (equal to 2 milligrammes per litre), but the writer believes that in the latest form of ozoniser, described above, these figures are improved upon. The Siemens & Halske ozoniser is in use for water purification at Martinikenfelde, near Berlin, at Wiesbaden, and at Paderborn, and some details of these installations will be given in the final section of this article.

The Tindal and Van der Steen Ozoniser.—This form of ozoniser is one of the type in which an external choking coil is used to minimise the danger from arc formation inside the apparatus.

The ozoniser was exhibited at Brussels in 1897, and has

been used experimentally in Belgium and France for water purification, but, so far as the writer is aware, no permanent installation of the Tindal and Van der Steen apparatus is in existence. The yield of this ozoniser is low, and according to figures published in 1897 is only 3 to 4 grammes per KW.-hour.

The Vosmaer-Lebret Ozoniser. — The Vosmaer-Lebret ozoniser is of the tube type, but differs from the Siemens and Halske ozoniser in the absence of glass as dielectric.

A patented device is employed to prevent arc formation, which the absence of any dielectric would favour, but no details of this very important adjunct of the Vosmaer-Lebret ozoniser have yet come into the writer's hands.

One of the metal tubes is provided with points from which the silent discharge occurs, and in order to minimise the danger to the users, the ozoniser is worked with one pole earthed, as in the Siemens & Halske apparatus. An E.M.F. of 10,000 volts is employed, and a number of separate ozonisers are grouped together in one ozonising apparatus.

Such a multiple ozoniser, with a capacity of 2,500 watts has been worked at Schiedam, in Holland, in connection with an experimental water purification plant, for eleven hours per day for two periods of six months—without the occurrence of any practical difficulties. Further details of this experimental plant will be found in the paper read by Prof. Van't Hoff before the ninth general meeting of the German Electro-chemical Society, at Wurzburg, in May, 1902.* No

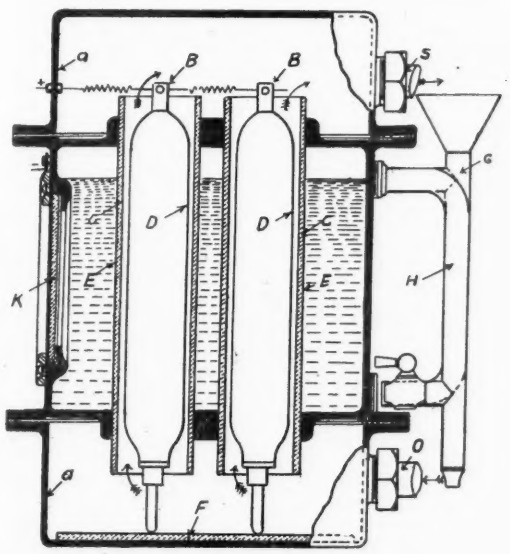


FIG. 4.

figures for the efficiency have been published, but an ozone concentration of 3·5 to 5·0 mgs. per litre of air is said to be easily obtained without the use of any cooling agency.

According to Prof. Van't Hoff, the water authorities of the city of Rotterdam are talking of installing the Vosmaer-Lebret apparatus for the sterilisation of a portion of their water supply.

The Yarnold Ozoniser.—The Yarnold ozoniser was described in the earlier article on this subject, and an experimental plant was operated in Lambeth for many months in 1897, 1898, and 1899, with the object of developing and exploiting industrial and commercial applications of this form of ozoniser. Owing to the death of the inventor, Mr. Yarnold, and to the failure of manufacturers to accord sufficient financial support, the syndicate financing this venture was obliged to go into liquidation, and so far as the writer is aware, the Yarnold ozoniser is not in industrial use in any works at the present day.

The fact that ozone is formed when the silent electric discharge is allowed to pass through air, or through pure oxygen gas, has been known since the early days of electrical science. The work of recent inventors and experimenters in this field of research, therefore, has been simply directed towards devising forms of apparatus which would be capable of practical application when dealing with large volumes of gas, and towards reducing the losses arising from spark formation and decomposition of the ozone already formed. The methods which have been adopted by different inventors to avoid the danger of spark formation vary greatly. In nearly all the ozonisers glass is used as dielectric between the electrodes. In some, a spark gap is provided in the external circuit, and if the conditions in the ozoniser proper should at times lead to sparking, the main discharge occurs in the external spark gap.

Other inventors make use of rotating electrodes, which vary in distance, or in which segmental openings have been made. Should sparking occur with these electrodes, the arc is speedily broken by the increasing distance or by the gaps produced by the rotation of the electrode or electrodes.

A third group of inventors use air currents sufficiently rapid to blow out any sparks that may form between the two electrodes, while yet another plan is to use a choking coil in the external circuit, which will not permit the current necessary to maintain an arc to pass into the ozoniser.

All of these principles are illustrated in the ozonisers described in this article.

* *Zeits. f. Elektrochemie*, July 24th, 1902.

NAVAL TELEGRAPH INSTRUMENTS.

ELECTRIC TELEGRAPHS.

EVER since electricity first made its appearance on board a man-of-war, the desirability of having some form of reliable telegraph worked by electrical means has made itself felt.

There have been several designs, but up to the present no instrument has proved satisfactory enough to warrant its universal adoption in preference to the telephone. The telephone is not quick enough for the majority of purposes; it requires a man in attendance, and during gun fire or any great noise it is practically useless.

What is wanted is a dial that can be placed in a conspicuous position and instantly read by an officer or responsible person in the vicinity.

Take, for instance, the question of range transmission. The modern system of armament is to have separate guns more or less isolated from one another by casements, that is to say, each gun with its crew and ammunition supply is enclosed in an armoured compartment. When in action an officer is stationed at the masthead with a sextant and a table of distances corresponding to certain angles, by which means he can calculate out the range and signal it to the deck, whence it is passed to the various guns; but the range is, of course, continually changing, and changing very rapidly in many cases, so that by the time the sights have been altered there is probably a considerable error. This error would, in a great measure, be obviated by the use of a general telegraph to all the quarters, worked from the main top.

We shall proceed to review the various forms of telegraph that have been introduced, and see in what way they have failed.

To begin with, there is the ordinary mechanical telegraph worked by rods, chains, or wire; in all of these there is the "back-lash," due to stretching, which causes the exact position of the indicator to be more or less unreliable, the inaccuracy, of course, increasing with the length of material used, which in turn is dependent upon the number of corners to be negotiated. Herein lies the great superiority of electric leads, and putting aside the question of weight and cumbersomeness, the ease with which repairs, either temporary or permanent, can be effected, completes the balance in favour of electricity.

The first electrical instruments to appear were what is known as step-by-step instruments, and the one which gave most promise of satisfaction was Lloyd's "engine-room indicator." Its principle was as follows:—

A series of impulses was sent from the transmitter to corresponding electro-magnets in the receiver, and an armature followed the magnets round in succession as they were in turn excited; the armature carried a pointer round the dial on the face of the instrument, and according to the last position of the handle of the transmitter, so it registered on

the receiver, when the current was automatically cut off by releasing the grasp of the handle.

So far as it went the actual working of the instrument was satisfactory, but it required a certain amount of skill in its manipulation, for it could not be relied upon to respond to a sudden or very rapid movement.

A second objection was that it required a separate line wire for each order, and this prevented it from being applied to any but engine room telegraphs. Willis and Robinson sought to improve upon it by disconnecting the handle from the actual switch in the transmitter and interposing a spring and mechanism attached to an air beater; this did away with errors due to too rapid movement. They also altered the type of receiver, using three separate armatures, one to each magnet. Each armature was in the form of a spring catch bearing against a star wheel, and the movement of these little catches in succession against the points of the star wheel caused rotation corresponding to the contacts made by the transmitter.

This instrument was suitable for a much wider field of use, but it was found to be unreliable on account of its fine adjustment. Teeth would be missed occasionally, and once this happened the instrument was useless, and displayed a wrong message. It never really passed out of the experimental stage, and was finally withdrawn.

In both these cases an alarm bell was worked by induction, and therefore did not interfere with the main circuit; the bell was, of course, worked by the common return of the three leads. Four wires were thus needed to convey as many messages as could be crowded into the dial. It was used for telegraphing to the engine room the number of revolutions required.

The next instrument we come to under this heading, is Richard's and Evershed's helm indicator, its object being to signal the number of degrees of helm starboard or port which the ship has on her. The transmitter is worked direct from the tiller, which thus automatically telegraphs its position to the conning tower.

The principle of its action is that of a resultant field created by two equal coils placed at right angles to one another, and controlling a strong magnetic needle which is geared to a pointer. The ratio of one coil to the other is determined by the relative resistance in the circuit of each, and this is determined by the position of the helm, which works an arm over a series of blocks with equal resistances between them.

When amidships, the arm lies centrally among the resistances, the current is fed through the arm and divides equally on either side, flowing through either coil back to a common return; the field now lies exactly central between the coils, and the needle takes up a corresponding position. There is, in fact, a true balance; but now if we suppose the tiller to have moved, it will have transferred a certain number of resistances from one side of the balance to the other, the ratio of the coils is correspondingly altered and the direction of the field changed, the needle follows the field and drags the pointer round the dial.

Another principle is brought into Evershed's range and order transmitter which is very similar in its action, but rather more sensitive. It is worked on the ratio coil principle, but the ratio instead of being altered by resistances, depends upon relative differences of potential derived from the brushes of a small motor transformer run off the main circuit; the balance is struck by a third brush lying midway between the main brushes on the commutator of this little secondary dynamo. The position of this brush can be altered at will, and as the ratio coils have each one terminal in connection with a main brush, and the other brought to the movable brush, very great relative changes in balance can be effected.

The last class of instrument is that in which the motion of the indicating pointer is dependent on clockwork; its main disadvantage is that it is liable to become run down if care is not taken to remember that the frequency of winding depends upon the amount of use it is put to, but this after all should not be a serious obstacle, as it is always provided with means of ascertaining the state of tension of its main spring.

Grenfell's instrument is very simple, and consists of a magnetic escapement. Transmitter and receiver are almost identical, and the clockwork tends to drive a contact wheel as long as the escapement permits it to move; the escapement is released magnetically, and locks the mechanism when the current is broken. On the contact wheel there is an arrangement for breaking the circuit at a certain position, and the displacement of this position determines how far the escapement will allow the mechanism to revolve before coming to rest in consequence of a broken circuit. The instrument has the disadvantage of being incapable of instant readjustment should it get out of order.

We now pass to Barr and Stroud's instrument, which is of the escapement class, and has some points similar to Willis and Robinson's, previously described. It does not require to be wound up at the transmitting end, for the movement of the handle compresses the spring at the same time as it makes the circuit, and the current actuates an escapement in the transmitter, releasing it and allowing the mechanism to work; here, again, we have a contact ring following the displaced handle until it is in its original relative position, where the circuit is automatically broken and the mechanism stops. So much for the actual message that is required to be sent; we have a piece of clockwork now working for a certain period of time before it is brought to rest, and it is required to reproduce an exact counterpart of its movement on the distant receiver. This is effected as follows:—

The receiver consists of an exactly similar clockwork arrangement with magnetic escapement, but here the escape is actuated by separate impulses, that is to say, every time the current passes one tooth is released.

Now, the transmitter escapement carries with it, as it goes round, a commutator, the effect of which is to send two impulses to line for every revolution of the escapement; in this way one revolution of the transmitter permits a revolution of the receiver, and thus the indicating hands on the dials of both instruments move in unison.

The instrument is complicated, however, by it being necessary for the hand to travel either way; this difficulty is met by practically combining two complete sets of instruments in a single set of cases, and working them in opposite directions. In order to control this double set with a single handle and a single indicating pointer, differential gear is employed; thus the instrument requires three wires—two line wires and a common return.

It is necessary to wind up the receiver at intervals. Barr and Stroud's range indicator is not universally adopted in our Navy as yet, but it has been successful in the Japanese warships. It possesses the decided advantage of adjustment should the instruments fail to correspond, all that is necessary to effect this being a movement of the transmitting handle.

AN ENGINEER'S FEES.

[From our Legal Contributor.]

The case of Robinson *v.* Earl Cadogan, in which judgement was delivered by Mr. Justice Lawrance on August 8th, raised a question of some interest to engineers respecting the amount which they are entitled to charge for services rendered. The action was brought by Prof. Henry Robinson to recover the sum of £401 0s. 5d. in respect of work done by him for the defendant in connection with a drainage scheme near Bury St. Edmunds. It appeared that the Corporation of Bury St. Edmunds had decided to effect certain alterations in a sewage farm which adjoined the defendant's property. An engineer drew up a scheme for the Corporation by which he estimated that the necessary works would cost £8,000. The plaintiff was employed by the defendant to advise him as to the efficacy of this scheme, and as the plaintiff alleged, to draw up an alternative scheme. Having done the work, the plaintiff sent in an account for £401 0s. 5d., which included an item of £10 10s. per day for 27½ days. The defendant, by his defence, alleged that the charges were excessive and unreasonable. It was also alleged in the course of the case that the plaintiff had never really been asked to draw up an alternative scheme. His function was merely to criticise the proposals of the Corporation and give evidence at a Local Government Inquiry in support of the defendant's views.

Mr. Justice Lawrance found on the facts that the plaintiff had not proved his retainer in respect of all the work for which he claimed remuneration. The charge of £10 10s.

per diem was reasonable; the complaint was that the charge had been made in respect of an unreasonable number of days. In the event the learned judge held that the sum of £120 which had been paid into Court was sufficient to satisfy the plaintiff's claim. This amounted to judgement for the defendant with costs, and as the defendant's costs will have to be satisfied out of the amount paid into Court, it is very doubtful whether the plaintiff will really recover anything.

From the facts as we have stated them, it is clear that no general principle can be drawn from this case. There was a dispute as to the facts, and this issue was decided in favour of the defendant. Nevertheless, the case points the moral that the work to be undertaken by an engineer should be specified in writing, and the terms of his remuneration arranged beforehand, howsoever eminent the client may be. Once it has been arranged that plans and specifications shall be prepared by the engineer, he is entitled to go ahead and demand reasonable charges for his services. Thus it is stated in a work dealing with the law relating to engineers that when the contract between the employer and the civil engineer or architect is simply that the latter shall prepare drawings in accordance with the employer's instructions, the civil engineer or architect, on the completion of the drawings in a skilful manner, is entitled to receive either the agreed payment, or, if no payment has been fixed, a reasonable payment for them. The fact that for any other reason than their own unfitness they are not used by the employer, and that, accordingly, he receives no benefit from them, in no way interferes with the professional man's right to remuneration. The latter has done all that he undertook to do, and, although the employer will not, or cannot, utilise the work, he must perform his side of the contract, and pay for it (Prickett *v.* Badger, 1 C.B.N.S. 296).

As to the case under notice, we cannot refrain from expressing sympathy for the plaintiff, who stands to lose the entire fruits of his labour, which extended over a considerable period of time.

BRITISH STANDARDS FOR ELECTRICAL MACHINERY.

Interim Report issued by the Engineering Standards Committee.

In publishing the Interim Report of the Sub-Committee on Generators, Motors and Transformers, it will be as well to draw attention to some of the important points which have arisen in carrying out the work entrusted to the Sub-Committee by the Electrical Plant Committee.

The Sub-Committee on Generators, Motors and Transformers was appointed at a meeting of the Electrical Plant Committee on December 18th, 1902, and confirmed by the Main Committee on February 13th, 1903. This Interim Report was approved by the Main Committee at their meeting on July 26th, 1904. At the earlier meetings it was decided that no attempt should be made to prescribe standard dimensions or shapes which might hamper future development in design, but to confine the recommendations of the Sub-Committee to such points as would ensure uniformity in nomenclature, outputs and test conditions.

The recommendations which the Committee have arrived at with reference to standard pressures, frequencies, outputs and speeds, were prepared after the views of both users and manufacturers had been very carefully considered.

Before standard test conditions can be laid down, the safe limit of temperature at which electrical machinery can be allowed to work for lengthened periods of time has, of course, to be determined. A Sub-Committee under the Chairmanship of Dr. Glazebrook was, therefore, formed to experimentally investigate this matter at the National Physical Laboratory, supplemented by tests at the works of those manufacturers who were willing to assist. The points to be investigated were the following:—

1. The maximum temperature to which the insulating materials at present used in the manufacture of electrical apparatus could be exposed for lengthened periods of time without electrical or mechanical deterioration.

2. The permissible rise in temperature deduced from these experiments.

3. The relation between the mean temperature of any coil obtained by measurement of rise in resistance and the maximum temperature at the hottest portion of the same coil.

In addition to these experiments, some of the coils which were tested singly at the National Physical Laboratory were subjected to a second series of tests when mounted on the machines for which they were intended, at the maker's works. The reports of this experimental work are likely to be of very great interest and value to the electrical industry at large, and the Committee hope to publish them in full, at an early date. It will be of interest to designers to note that the experimental work has made sufficient progress to indicate with considerable certainty that the temperature limits ultimately to be recommended by this Sub-Committee are likely to be more liberal than those laid down by either the American or German Electrical Standardisation Committees. The experiments have also demonstrated that the temperature of the hottest part of the coils, taken by thermo junction, is no more than 25° C. in excess of the mean temperature of the coil, taken by rise in resistance.

The question of settling the standard electrical pressures did not meet with as much difficulty as was anticipated. Care was taken to select those standard pressures which, with the allowable variation of 10 per cent. on either side, would enable nearly all the pressures at present existing to be served by the proposed standard machines. These standard pressures have now been fixed, and it is hoped that *in all future work* they will be universally adopted by engineers who are advising power companies, corporations, supply companies, and others engaged in the distribution of electrical energy, so that in these cases the permissible variations will gradually cease to be necessary.

The standard frequencies proved to be a debatable matter, and after several circular letters had been addressed to, and replies received from, both users and makers, it was deemed advisable to convene a Conference, so that the matter might be thoroughly discussed. This Conference was held early in January, and the advisability of adopting two or three standard frequencies was fully considered, especially from the point of view of the future developments in power schemes. Strong evidence was brought forward in favour of standardising one frequency only, and the Sub-Committee after due consideration decided to recommend 50 periods per second as the standard frequency, placing 25 periods per second in a secondary category.

The question of recommending standard lists of motor speeds, which appeared so desirable from the users' point of view, was found to be an extremely difficult one. The Sub-Committee felt that they could not materially assist manufacturers in reducing the number of patterns to be kept in stock, if a greater number of speeds were retained than those recommended in the standard lists. Happily, one list of speeds, namely that for prime movers, was practically fixed for the Committee by the conditions of the frequency and the number of the poles in the alternators, so that the Committee decided to put forward this one list of speeds for the whole of the direct coupled machinery of both classes.

The Sub-Committee on Generators, Motors, and Transformers are indebted to the Transformer Sub-Committee for the recommendations with reference to alternating current generators. They have still under consideration the very important subjects of the standardisation of transformers, test conditions, and permissible variations from the adopted standards, and the complete report cannot be published until such time as these investigations are concluded. The Committee, however, feel that the interests of the electrical profession will best be served by the early publication of a portion of the information which will ultimately be embodied in the report when complete.

R. E. B. Crompton,
Chairman of Sub-Committee on Generators, Motors, and Transformers.

A list of the members of the Sub-Committees, by whom the standards for generators, motors, and tranformers are being drawn up, was given in a recent issue.

Pressures and Frequencies.—The following are the resolutions with reference to British standard pressures and frequencies:—

1. Resolved that the standard low pressures for direct and alternating current work, measured at the terminals of the consumer, be:—110, 220, 440, 500 volts.

Though not included in the above standard pressures, 380 volts shall be considered as the recognised pressure to be maintained between the principal conductors in a three-phase system with neutral wire, the pressure then being 220 volts between the three conductors and the neutral.

2. Resolved that the standard high pressures for alternating current work, measured at the terminals of the generator, be:—2,200, 3,300, 6,600, 11,000 volts.

3. Resolved that the standard primary pressures for alternating current transformer work, measured at the primary terminals of the transformer, be:—2,000, 3,000, 6,000, 10,000 volts.

4. Resolved that the standard secondary pressures for alternating current transformer work, measured at the secondary terminals of the transformer, be:—115, 230, 460, 525 volts at no load.

5. Resolved that the standard direct current pressure for tramway work, measured at the terminals of the motor, be:—500 volts.

6. Resolved that the standard frequency for alternating current work be:—50 periods per second. But where the circumstances of the case demand a lower frequency, a standard of 25 periods per second shall be adopted.

N.B.—The above standard pressures are subject to a permissible variation of 10 per cent. on either side, as explained in the introduction.

Rating of Generators and Motors (except for Traction Motors).—1. Two ratings shall be recognised by the British Engineering Standards Committee:—(A) Continuous working; (B) Intermittent working.

(A) The output of generators and motors for continuous working shall be defined as the output at which they can work continuously for *six hours* and conform to the prescribed tests.

(B) The output of motors for intermittent working shall be defined as the output at which they can work for one hour and conform to the prescribed tests.

N.B.—The duration of test for machines above 250 KW. is still under consideration.

2. Every generator and motor shall carry, in a conspicuous position, a name-plate giving the output and other particulars enumerated below. In the absence of any statement to the contrary, the output given shall always be understood to mean the output for continuous working under Rating (A). Name-plates for machines under Class (B) shall bear the word "intermittent."

3. The output and full load speed marked on the name-plate shall be those taken when the machine is at its normal working temperature, as determined at the close of the test run referred to above.

4. All generators shall have their outputs stated in kilowatts (KW.). All motors shall have their outputs stated in B.H.P.

5. The following information shall be given on the name-plates:—

Generators	Direct current.	KW.	Volts.	Amps.	r.p.m.
	Alternating current.	KW.	Volts.	Amps.	Power factor.
		Full load.	Volts.	Frequency.	r.p.m.
		Excitation.	Amps.		
Motors	D.C. (continuous working) B.H.P.		Volts.		r.p.m.
	D.C. (intermittent working) B.H.P. (intermittent)		Volts.		r.p.m.
	A.C. (continuous working) B.H.P.		Volts.		r.p.m.
			Frequency.		Power factor.
	A.C. (intermittent working) B.H.P. (intermittent)		Volts.		r.p.m.
			Frequency.		Power factor.

The above applies to combined machines, such as motor-generators, boosters, rotary converters, which shall have name-plates giving information applying both to input and output.

Direct-Current Generators.—6. The List Nos. represent the KW. which the machine can work at when running continuously as a generator. List Nos. and speeds of direct-current generators (up to 100 KW.):—

List No.	Standard motor carcase.	R.p.m.	List No.	Standard motor carcase.	R.p.m.
6	7½	1,075	32	40	750
8	10	1,000	40	50	675
12	15	900	60	75	625
16	20	850	80	100	575
24	30	800	100	—	500

British Standard generators of 100 KW. and above, whether for direct or alternating-current work, shall conform to the following list of sizes and speeds recommended for generators to be directly coupled to steam or gas engines.

KW.	Revolutions per minute.		
	Slow.	Medium.	High.
100	*	250	500
150	*	250	428
200	*	250	375
250	*	250	375
300	94	214	375
400	94	214	375
500	83	214	300
750	83	188	250
1,000	83	188	250

N.B.—The "Slow" speeds in the above table are tentative.

Alternating Current Generators.—7. British standard alternators of any type, in addition to the requirements laid down in previous clauses, in so far as the latter apply, shall conform to the following regulations:—

(*a*) They shall give an E.M.F. curve which, under all working conditions, shall be as nearly as possible a sine wave.

(*b*) For exciting the field magnets the standard pressures shall be:—65, 110, or 220 volts.

(*c*) The term "alternator" shall not include an "exciter." The latter, when necessary, shall be separately specified and subject to the regulations for standard direct-current generators.

(*d*) The regulation of an alternator shall be defined as the difference between the rated full-load pressure and the no-load pressure with the same speed and excitation. This difference expressed as a percentage of the rated full-load pressure shall be termed the percentage "pressure rise" of the alternator.

(*e*) They shall not have a greater percentage pressure rise than 6 per cent. on a non-inductive load and 20 per cent. on an inductive load, the latter being here considered as one having a power factor of 0·8.

This pressure rise may be tested on a non-inductive or inductive load according to the requirements of the specification.

The figures in (*b*) and (*d*) shall not apply to compounded alternators.

Motors.—8. All motors for the purposes of tests shall be rated under the following classes:—(1) Open; (2) protected; (3) ventilated; (4) totally enclosed.

(1) and (4) require no definition.

2. A *protected* motor is defined as a motor, in which the armature, field coils and other live parts are protected mechanically from accidental or careless contact, so as not to materially interfere with ventilation.

3. A *ventilated* motor is defined as a motor in which, while ventilation is provided for, access to the armature, field coils and other live parts is only to be obtained by opening a door in, or removing a portion of, the enclosing case.

N.B.—An alternating current motor, Class (3), in which the slip rings are outside the protection, shall be considered as coming under Class (2).

Lists of Motors.

9. The list Nos. represents the B.H.P. which the machine can work at when running continuously as a motor, at the standard pressure of 220 volts, up to and including two (2) B.H.P., and above that size, at the standard pressure of 440 volts.

10. The following are the list Nos. of British Standard sizes of motors:—

List Nos. (direct current).
¼, ½, 1, 2, 3, 5, 7½, 10, 15, 20, 30, 40, 50, 75, 100.

List Nos. (single phase) 50 ~
1, 2, 3, 5, 7½, 7½A, 10, 10A, 15, 20, 25.

List Nos. (two- and three-phase) 50 ~
1, 2, 3, 5, 7½, 7½A, 10, 10A, 15, 20, 25, 30, 40, 50, 50A, 75, 100.

11. List Nos. and speeds of motors (up to — B.H.P.).

DIRECT-CURRENT MOTORS.

List No.	R.p.m. at full load.	List No.	R.p.m. at full load.	List No.	R.p.m. at full load.
¼	1,600	5	1,000	30	750
½	1,400	7½	1,000	40	700
1	1,400	10	900	50	650
2	1,100	15	850	75	600
3	1,100	20	800	100	550
ALTERNATING-CURRENT INDUCTION MOTORS.—SINGLE-PHASE, 50 ~					
1	1,500	7½	1,500	15	1,000
2	1,500	7½A	1,000	20	1,000
3	1,500	10	1,500	25	750
5	1,500	10A	1,000	—	—
TWO AND THREE-PHASE, 50 ~					
1	1,500	10	1,500	40	750
2	1,500	10A	1,000	50	750
3	1,500	15	1,000	50A	600
5	1,500	20	1,000	75	600
7½	1,500	25	750	100	500
7½A	1,000	30	750	—	—

The figures referring to A.C. motors give the no load or synchronous speeds, allowance should, therefore, be made for a reduction in speed at full load of, from about 7½ per cent. in the smallest motors to 2½ per cent. in the largest motors.

28, Victoria Street, Westminster. *July*, 1904.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"OFFENDER" writes:—"A municipal electricity department erected a feeder pillar box in a pavement, which, although in a public street, was the property of, and repairable by, the owner of the adjoining property. By an oversight the owner did not receive the three days' notice necessary under the Gasworks Clauses Act.

"Has the owner power to enforce the removal of said box, or, if not, can he claim compensation beyond putting the pavement into proper repair?"

*** So far as can be ascertained by reference to the Electric Lighting (Clauses) Act, 1899, Sec. 15 (*h*), if the undertakers make default in complying with any of the requirements or restrictions of this section, they shall (in addition to any other compensation which they may be liable to make under the provisions of the special order or the principal Act) make full compensation to the owners affected thereby for any loss or damage which they may incur by reason thereof, and, in addition thereto they shall be liable for each default to a penalty not exceeding £10, and to a daily penalty not exceeding £5. Provided that the undertakers shall not be subject to any such penalty as aforesaid, if the Court are of opinion that the case was one of emergency, and that the undertakers complied with the requirements of this section so far as was reasonable under the circumstances. The above section appears to be sufficient to render "Offender" liable. Moreover, it is clear from the interpretation which has been put upon those provisions of the Gasworks Clauses Acts which are incorporated with the

Electric Lighting Acts, that where without parliamentary authority, and without the consent of the owners of the subsoil of a public highway, water pipes were laid in such subsoil, the owner was held to be entitled to an injunction to restrain the continuance of the pipes [Goodson *v* Richardson (L.R. 9 Ch. 221)]. In the circumstances, "Offender" had better compromise any claim which may be made against him, rather than allow the private owner to stand on his strict rights.

BRITISH ELECTRIC TRAMWAY WORK IN THE EAST.

Messrs. Dick, Kerr & Co., Ltd., have recently obtained a contract for electric tramway plant and material for Bangkok tramways, owned by the Siamese Tramways Co., Ltd. The contract includes power-house equipment, which consists of three 200-kw. 500-volt d.c. generators of Dick, Kerr's standard type coupled direct to three Browett-Lindley vertical compound engines, and the usual accessories, including surface condensers, pumps, &c. There are also 40 single motor equipments of Dick, Kerr's standard 25-B type, mounted on Brill 21-E trucks, and the whole of the rails, fish-plates, and tie-bars for the line, which has a total length of 13½ miles.

The Mandalay tramways have just recently been successfully opened by the Lieut.-Governor of Burma, Sir Hugh Barnes, K.C.S.I., K.C.V.O., and the system is now in operation. The total length of the tramways is 12 miles of single track, laid to a gauge of 3 ft. 6 in., with rails of the girder type, weighing 85lbs. per yard. The overhead equipment is on the span-wire system, and is of a very neat and rigid design. The rolling stock consists of 24 single-deck, open, cross-bench cars to accommodate 48 passengers, built by the Electric Railway and Tramway Carriage Works, Preston. The cars are mounted on Brill maximum trucks, each car being supplied with a complete electrical equipment, consisting of two Dick, Kerr's standard 25-B motors with DB1 form "C" controllers. The power house equipment consists of three Dick, Kerr's d.c. compound-wound 200-kw. 400 r.p.m. 500/550 volt generators, direct coupled to three Belliss compound engines; the switchboard, which was built by Dick, Kerr & Co., is in accordance with standard traction practice, and consists of four feeder panels, three generator panels, one testing panel, and one panel for motor and lighting circuits.

The electric tramways of Hong Kong are rapidly approaching completion, the same firm also being the contractors. The total length of single track is 14½ miles, and is laid to a gauge of 3 ft. 6 in., with girder type rails weighing 86 lbs. per yard. The overhead line within the city is centre-pole construction, but outside the city boundary the side pole system is used. The power house is as nearly as possible in the centre of the system; the plant consists of two of Dick, Kerr's standard d.c. 300-kw. railway generators of the multipolar type, compound-wound, running at a speed of 100 r.p.m. at 500 volts, direct coupled to the main shaft of two engines, built by Messrs. Yates & Thom; in addition to the two traction sets, two combined sets for the arc and incandescent lighting of the depôt have been installed. The switchboard, built by Dick, Kerr & Co., consists of two generator panels, two feeder panels, three lighting panels, one main station panel, and one B. of T. panel. The boiler house contains two Babcock & Wilcox water-tube boilers and the usual accessories. Twenty-six single-deck cars are provided, 10 being of the combined type, with an enclosed portion in the centre and an open platform with seats at either end, and have a seating capacity for 32 passengers; the remaining 16 cars are of the open cross bench type to seat 48 passengers. The cars were built by the Electric Railway and Tramway Carriage Works, Ltd., and each is mounted on a Brill 21E truck and fitted with two of the contractor's standard four-pole series-wound motors of 25 h.p., and at either end of the car is one of the same firm's standard DB1 form C controllers. As this is the pioneer system of electric traction in China, it is hoped the venture will meet with success, and that electrically-equipped lines will shortly be laid in other parts of the Celestial Empire.

Singapore tramways are in the hands of the same contractors, and are making considerable progress. The power house contains eight Lancashire boilers, with the usual accessories, including two fuel economisers and four feed pumps. There are two of Yates and Thom's horizontal cross-compound condensing type engines, coupled direct to two of Dick, Kerr's standard 500-kw., 100-r.p.m. 500-volt compound generators. For lighting purposes a 200-kw. plant has been installed, including a direct-current generator of 150-kw. capacity, coupled direct to a Willans engine, also a 50 kw. motor-driven generator working off a circuit of 550 volts. A suitable switchboard has been supplied and erected. The overhead work has been carried out on the span-wire system. The total length of single track is 27 miles, and is laid to a gauge of 1 metre, and the form of construction consists of laying girder type rails weighing 95 lbs. per yard upon a continuous beam of concrete. The rolling stock consists of 50 cars, 20 single deck, single truck combination type with a seating capacity of 32 persons, 16 inside and 16 outside, and 30 of the open cross-bench type to seat 40 persons; they are mounted on Brill 21E trucks, and equipped with Dick, Kerr standard 25B motors and DB1 form "C" controllers. In addition there are 33 goods vans mounted on Brill 21G trucks, each with a double motor equipment; the whole of the rolling stock was built at Preston.

Lastly, the Calcutta Tramways Co. is carrying out considerable extensions, and this work also has been entrusted to the original contractors, Messrs. Dick, Kerr & Co., Ltd. It includes an additional 10 open-type motor cars, in all respects similar to those supplied before, *i.e.*, single-deck open type cars mounted on Brill 21E trucks, and equipped with two of Dick, Kerr's standard 25A motors, each with a DB1 form C controller.

The main station plant is being increased by one of Dick, Kerr's standard three-phase alternators, 500 kw., 25 cycles, six 6,000 volts, 94 r.p.m. direct-coupled to a Yates & Thom horizontal cross-compound engine, and a switchboard built by Dick, Kerr & Co. There are two sub-stations being erected, in which will be placed one of the firm's standard 300 kw. rotary converters with the necessary transformers and switchgear.

The Fixation of Atmospheric Nitrogen.—Dr. B. Schultze has recently read a paper before the Chemical Society of Breslau on the above subject. Referring to the electrical methods of preparing nitric acid, he stated that in the works of the Atmospheric Products Co. at Niagara, 2·5 per cent. by volume of the air treated is now being obtained as nitric oxide (NO), from which nitrogen pentoxide (N_2O_5) is being produced at the rate of 0·45 kilogramme per 7 h.p.-hours. In their experimental plant at Munich, Muthmann and Hofer are obtaining 3·6 per cent. by volume of NO, and in Vienna Dr. von Lepel has succeeded in recovering as much as 6 per cent. The cost of producing the nitrogen pentoxide, however, is so high, that this method can hardly compete with the preparation of acid from Chile saltpetre; besides which, the acid is always contaminated with nitrous compounds. The author went on to discuss the new substance, calcium cyanamide, or "Kalkstickstoff," made from calcium carbide. He considered that the experiments hitherto carried out show it to be immediately suitable for use as a fertiliser, and that it might be considered a perfect substitute for nitric-nitrogen. As usually made, it contains from 18 to 21 per cent. of nitrogen. By the manufacture of calcium cyanamide, therefore, atmospheric nitrogen may be fixed in any desired amount, and the fear that eventually an agricultural famine in nitrogen may arise, is entirely removed.

Canals and Trade.—If by increasing the cost of raw materials, as is undoubtedly done in this country by the heavy railway charges on rough material, such as coal and pig-iron, there is produced less of finished and half-finished products, the inference to be drawn is not only that the railways do not carry the manufactured goods which are not made, but they do not even secure the carriage of the raw material which ought to be used in the manufacture. Thus, by the cheaper carriage of raw materials on canals there would be goods of a higher class that could possibly stand the high railway charges. In Germany the canals, as in Belgium, are looked on as a means of carrying low-class traffic cheaply in order that higher class goods may be produced to bear the higher rates proper to their class, and there are now no fewer than five important canal schemes under consideration, four of which relate to improvements and enlargements of existing canals, and the fifth relates to a new canal near the Ruhe estuary from the Rhine. This will utilise in part the existing Ems to Dortmund canal. The want of canals in this country is emphasised by the importance which is attached to the proved westerly extension of the South Yorkshire coalfield, in which ten miles west of any existing colliery, four seams, totalling 18 ft., have been proved at Haxey, and the present agricultural district, the Isle of Axholme, will soon be a most important colliery centre. Now, these new collieries are near the seaboard, and this, in the absence of canal facilities, is of great importance in the competition for sea-borne custom. If canals are of so much importance to Belgium and to Germany, where railway charges are much more moderate than they are on English lines, how much more important should they be to Great Britain. It is impossible to believe that railway charges on coal to London are not excessive. On the Midland this traffic is conducted by very slowly-trundled trains, which appear to be run with a minimum of effort at a speed scarcely greater than canal speed. Nor, when once established, and the demand caught up with, need material like coal be hurried along. So long as the line is carrying all the traffic it is asked to carry, the only cost of slow speed is the interest on the extra number of engines and vehicles, and the extra wages of the train staff per ton-mile, items that have to be equated with decreased wear and tear of track and vehicles. On American lines where ton-mile charges are low for goods, the speed is very slow and trains are long and heavy, so as to reduce the wages cost of the train staffs.

Mr. Sauer (of the Weaver Navigation) says that barges of at least 300 tons should be taken by our canals, and with such loads as this size renders possible, the wages account per ton would be very small.

Lightning Research.—Mr. Killingworth Hedges, M.I.C.E., hon. secretary of the Lightning Research Committee, will read a paper at the meeting of the British Association, Section G, entitled "The Effects of Lightning." As there are some forty reports from the observers of the Lightning Research Committee on lightning strokes by which more or less damage has happened to buildings fitted with the so-called lightning conductors, Mr. Hedges' paper will, in all probability, be worth the attention of architects and others who have to consider the subject. We understand that the whole question is under the consideration of a sub-committee, whose names are:—Sir Oliver Lodge, F.R.S.; Mr. J. Gavey, of the G.P.O.; and Mr. Killingworth Hedges; and that their recommendations will be sent on to the General Committee, who will, in due course, issue their report.

ELECTRICAL ENGINEERING PROGRESS IN ITALY.

THE *Electrotechnische Anzeiger*, in a recent issue, devotes considerable space to an article on the present position of the electrical engineering industry in Italy. The grave crisis which the industry has been passing through during the past two years, and which extended to Italy, appears to have attained its highest point during the first six months of 1903. In the course of the second half of the year, a distinct improvement took place, not only in the importation of foreign electrical machinery into Italy, but also in the contracts given out to native concerns, and the improved condition of things has become accentuated in the first half of the current year. The foreign electrical firms which have secured a definite footing in Italy are the group formed by the Allgemeine Co of Berlin and the Thomson-Houston Co.; the Siemens-Schuckert Co; and Messrs. Brown, Boveri & Co., of Baden, Switzerland. After a long struggle, the native electrical engineering concerns have succeeded in overcoming the prejudice against their products, and are now fairly well employed. With the object, however, of better meeting foreign competition, a form of syndicate has been arranged between three of the native firms, Messrs. Gadda & Co., and Messrs. Brioschi, Finzi and Co., both of Milan, and between whom an agreement has for some time been in force, having been joined by the Società Elettricita Italiana, of Turin. Under the agreement now existing between these three concerns, the commercial and technical portions of the business are exclusively controlled by a committee consisting of the directors of the three firms, the orders being divided between the latter by the committee. Under the arrangement Messrs. Gadda take 45 per cent of the net profits, Messrs. Brioschi, Finzi, 22 per cent., and the Società Italiana 33 per cent. The capital of the concerns is, respectively, £160,000, £60,000, and £60,000, or a total of £280,000. The largest dynamos so far, turned out by Messrs. Gadda, were supplied to La Società Conti, of Milan, for its power station at San Pietro, near Bergamo; they were each of 2,000 H.P. According to our contemporary, the three firms named above are the only electrical engineering concerns in Italy. Another one which might be mentioned is the branch of Messrs. Brown, Boveri & Co., which, however, has so far confined itself to the production of measuring instruments, and the like, the orders for dynamos being sent to the head works in Switzerland. To give a complete enumeration, the shipbuilding firm of Ansald -Armstrong, of Genoa, which is also making dynamos, should be mentioned. Under the auspices of the Banque Commerciale, the Credit Italien, and Messrs. Gadda & Co., a concern known as La Societé Hydraulico-Elettricità Ligurienne, has lately been formed, with a capital of £100,000. The object of the concern is to put down plant to utilise the water power of several streams in the Spezia district. It is expected that about 3,000 H.P. will be available, and contracts have been arranged with the Italian Government for the supply of the bulk of the energy generated for power purposes in the arsenal; the remainder will be employed for tramway traction purposes, and for municipal lighting in Spezia. The power station to be established will comprise five turbines and five alternating current dynamos of 1,500 H.P. each, the contract for the latter having been secured by Messrs. Gadda.—*L'Electricien.*

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

16,842. "Convertible electric cable-connecting box for twin and single-cored or wired waterproof cables." G. W. OWEN. August 2nd.

16,846. "Improvement in time element devices applicable to electric circuit-breakers and other apparatus." J. G. STATTER. August 2nd.

16,853. "An improved method of signalling for electric tramcars and the like." G. WRIGHT. August 2nd.

16,871. "Receiving telegraph instrument." C. R. UNDERHILL. August 2nd. (Complete.)

16,875. "An improved method of indicating the stopping places of electric and other street cars by day and night." F. COCHRANE. August 2nd.

16,879. "A semi-reclining electric light bath." C. M. HOLMQUIST. August 2nd.

16,884. "A safety cable and suspender for the transmission of electric currents." E. M. GINDERS. August 2nd.

16,894. "Improvements in apparatus for electrically indicating the position of railway signals, points, or other gear." SIEMENS BROS. & Co., LTD., and L. M. G. FERREIRA. August 2nd. (Complete.)

16,932. "Improvements relating to electro-magnetic brakes for vehicles." E. KRAMER. (Date applied for under Patents Act, 1901, August 7th, 1903, being date of application in Germany.) August 2nd. (Complete.)

16,964. "Improvement in the arrangement for lighting and extinguishing gas by the application of electricity." G. HILL. August 3rd.

16,978. "Art of electrical signalling." C. R. UNDERHILL. August 3rd.

17,016. "Improvements in electric motor control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co, United States. August 3rd.

17,017. "Improvements in electric motor control systems." THE BRITISH THOMSON-HOUSTON CO, LTD. (The General Electric Co., United States.) August 3rd.

17,018. "Improvements in electric pneumatic control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co, United States.) August 3rd.

17,019. "Improvements in alternating current motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 3rd.

17,021. "Improvements in electric motor control systems." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 3rd.

17,022. "Improvements in electric meters." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 3rd.

17,023. "Improvements in electric switches." THE BRITISH THOMSON-HOUSTON CO, LTD. (The General Electric Co., United States.) August 3rd.

17,024. "Improvements in electric controllers for electric circuits." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) August 3rd.

17,029. "Improvements in connection with guards for trolley wheels of electric tramways and the like." R. SHAW. August 3rd.

17041. "Improvements in supports or insulators for telegraph and other wires." S. GARLAKE. (W. R. Portingale and H. W. Godwin, Cape Colony.) August 3rd.

17,043. "Improvements connected with electric bells, indicators, and domestic telephones." S. A. BRISEY. August 3rd.

17,046 "A system of electric traction for railways and tramways." A. MARSHALL. August 4th. (Complete.)

17,051. "Improvements in and relating to electrical switches known as tumbler switches." G. SPERRYN and W. H. WOOD. August 4th.

17,058. "Improvements in apparatus for operating the points of electric tramways." W. R. EVANS. August 4th.

17,059. "Improvements in electro-magnetic controlling devices." H. M. DARRAH and L. A. HACKETT. August 4th.

17,121. "Improvements in and relating to the electrolytic deposition of metals." S. O. COWPER-COLES. August 4th.

17,133. "An electric governor for internal combustion engines." G. A. E. ROBERTS. August 5th.

17,140. "Covering a live electric rail." R. PARKIN. August 5th.

17,147. "Sparking plug tester." G. H. WOODS. August 5th. (Complete.)

17,160. "An improved chain for suspending electroliers and the like." C. I. CLEMENTS. August 5th.

17,166. "Improvements relating to gas or vapour electric apparatus." S. E. FLICHTNER. (Date applied for under Patents Act, 1901, August 10th, 1903, being date of application in United States.) August 5th. (Complete.)

17,176. "Improvements in and connected with electric arc lamps." G. PERITZ August 5th.

17,181. "Improvements in contact devices for apparatus for electrically lighting and extinguishing gas." J. F. TESTOR. August 5th. (Complete.)

17,190. "An improvement in the manufacture of electric glow lamps to represent candles." E. A. GIMINGHAM. August 5th. (Complete.)

17,191. "Manufacture of filaments for electric glow lamps." O. IMRAY. (A. de Madaillan, France.) August 5th.

17,196. "Improved manufacture of plates and electrodes for electric accumulators and storage batteries." G SCHAULI and G. PETRIDES. August 5th.

17,201. "An improvement in third-rail systems for electric railways." A. E. HARDAKER. August 6th.

17,220. "A system of connecting monophase motors having armatures furnished with collectors employed in connection with electric rails, and working together in pairs." UNION ELEKTRICITATS-GESELLSCHAFT (IN LIQUIDATION). (Date applied for under Patents Act. 1901, August 8th, 1903, being date of application in Germany.) August 6th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

METHOD OF AND APPARATUS FOR MAINTAINING UNIFORM SPEED IN ELECTRIC MOTORS. Siemens Bros. & Co, Ltd. (Siemens & Halske, Actien-Gesellschaft.) 21,305. October 3rd.

SWITCHES FOR STARTING AND REGULATING ELECTRIC MOTORS. J. T. Mould. 7,618. April 1st.

MEANS FOR CONTROLLING THE WORKING OF PERIODICALLY OPERATING ELECTRIC MACHINERY. J. Y. Johnson. (The Elektrizität Aktien-Gesellschaft vormals W. Lahmeyer & Co., Germany.) 7,716. April 2nd.

LIFEGUARDS FOR ELECTRIC TRAMCARS AND OTHER VEHICLES. J. Bowring. 7,819. April 4th.

ELECTRIC FUSE BOXES. E. A. Carolan. (General Electric Co., United States.) 9,810. April 30th.

METHOD OF MAKING ELECTRIC SWITCH COVERS. T. Bond, A. Deacon, and J. H. Leather. 10,871. May 13th.

ELECTRIC FUSE PLUGS. E. A. Carolan. (General Electric Co., United States.) 11,609. May 21st.

APPARATUS FOR CONTROLLING AND OPERATING THE RAIL POINTS AND OVERHEAD POINTS OR FROGS OF ELECTRIC AND OTHER RAILWAYS AND TRAMWAYS. T. O'Neill. 12,260. May 29th.

APPARATUS FOR ELECTRIC LIGHTING. F. W Le Tall. (The Cooper-Hewitt Electric Co., United States.) 14,163. June 25th.

ADJUSTABLE SUPPORT OR CARRIER FOR AN INCANDESCENT ELECTRIC LAMP. E. Taylor. 18,602. August 28th.

DOUBLE POINT FOR ELECTRIC RAILS OF THE CONDUIT SYSTEM, SO THAT THE CAR CAN ALWAYS PICK UP THE CURRENT. A. C. Holbrow. 18,712. August 31st.

ELECTRIC FURNACES. C. P. E. Schneider. 28,805. December 31st.

PHASE MEASURING INSTRUMENTS FOR ELECTRIC CURRENTS. A. C. Heap. 8,048. April 7th.

CONTROLLING SYSTEMS FOR ELECTRIC MOTORS. G. Westinghouse. 8,256. April 9th.

ELECTRIC SWITCHES. T. von Zweigbergk. 8,279. April 9th.

ELECTRIC SWITCHES. T. von Zweigbergk. 8,280. April 9th.

ELECTRIC REVERSING SWITCH. S. H. Heywood and H. W. Heywood. 8,343. April 11th.

ELECTROSTATIC VOLTMETERS. J. Furguson and Kelvin and James White, Ltd. 8,791. April 18th.

INTERLOCKING ELECTRIC SWITCHES AND CUT-OUTS OR THE LIKE CIRCUIT BREAKERS, SUITABLE FOR USE IN MINES OR THE LIKE SITUATIONS. A. Eckstein and A. J. D. Krause. 8,800. April 18th.

APPARATUS FOR PLAYING A GAME OF SKILL, AND ADMINISTERING ELECTRICITY INTO THE SUCCESSFUL PLAYER. H. C. Rose. 8,826. April 18th.

PLUG AND SOCKET CONNECTIONS AND SWITCHES FOR ELECTRICAL PURPOSES. G. M. Sellick. 9,131. April 22nd.

ELECTRIC SWITCHES FOR RAILWAY POINT AND SIGNAL MECHANISM. W. R. Sykes 10,504. May 8th.

ELECTRIC CABLES. A. Whalley. 11,473. May 20th.

ELECTRIC SWITCHES. E. A. Carolan. (General Electric Co., United States.) 11,726. May 22nd.

ELECTRIC MOTORS. E. A. Carolan. (General Electric Co., United States.) 12,887. June 8th.

TROLLEY HEADS FOR ELECTRICALLY-PROPELLED VEHICLES. J. Major. 13,009. June 10th.

SHADE HOLDERS FOR ELECTRIC LAMPS. G. Chisholm. 13,153. June 12th.

IMPROVEMENTS IN ARMATURE COILS FOR DYNAMO-ELECTRIC MACHINES. The British Westinghouse Electric Manufacturing Co., Ltd. (The Westinghouse Electric and Manufacturing Co., United States.) 14,539. June 30th.